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ABSTRACT

This booklet describes the goals and activities of 20 exemplary programs in mathematics, science and technology for students and teachers in schools operated or funded by the Bureau of Indian Affairs. The programs are: "Computer Home Improvement Reading Program," Beclabito Day School (New Mexico); "Cherokee High School Science: Honoring Tradition/Seeking the Future," Cherokee Central High School (North Carolina); "Making Connections," Cheyenne-Eagle Butte School (South Dakota); "Effective Math and Science Strategies on the Navajo Reservation," Cove Day School (New Mexico); "Dennehotso Boarding School Library-Media Center," (Arizona); "Image Processing for Teaching," Dzilth-Na-O-Dith-Hle Community School (New Mexico); "Radio Broadcasting Program," Greyhills Academy High School (Arizona); "Haskell Math and Science Summer Workshop," Haskell Indian Nations University (Kansas); "Reclaiming the Desert with Native Plants," Little Singer Community School (Arizona); "SMILE: Science and Mathematics for Indian Learners and Educators," Northern Arizona University; "BIA Hands-On Science and Mathematics Workshop," Sandia National Laboratories (New Mexico); "RAISE: Rural American Indian Science Education Workshop," Sandia National Laboratories (New Mexico); "San Simon Elementary School Math Technology Program" (Arizona); "Science Education Training Project Workshop(s)," Sinte Gleska University (South Dakota); "SIPI College Bound Math and Science Enrichment Program," Southwestern Indian Polytechnic Institute (New Mexico); "Community Academies for Science and Mathematics," Taos Day School (New Mexico); "Native Americans in Science Program," Theodore Jamerson Elementary School (North Dakota); "Science Enrichment Program," Turtle Mountain Community High School (North Dakota); "Computers for Life Program," Tuba City Boarding School (Arizona); and "University of Arizona Holistic Science and Whole Language Works." Appendix A lists some past and contemporary American Indians in science, medicine, and technology. The bibliography in Appendix B lists over 100 resources for teachers and students. (SAS)

1995 Bureau of Indian Affairs
Outstanding Programs in Math, Science and Technology

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Bureau of Indian Affairs
U.S. Department of the Interior
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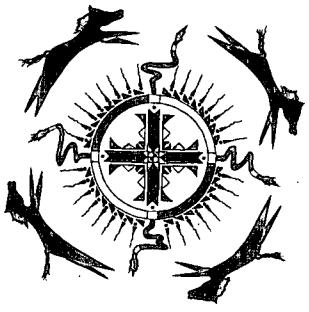

Cover Art by:
Darrell Miller, Wichita Tribe
10th Grade, Takini School, HC 77, Box 537, Howes, SD 57748

"The Nurturing of Earth."
The circle represents the Earth. The red lines going outward from the circle are messages to the Four Nations telling them that Earth cannot survive alone and needs our support.

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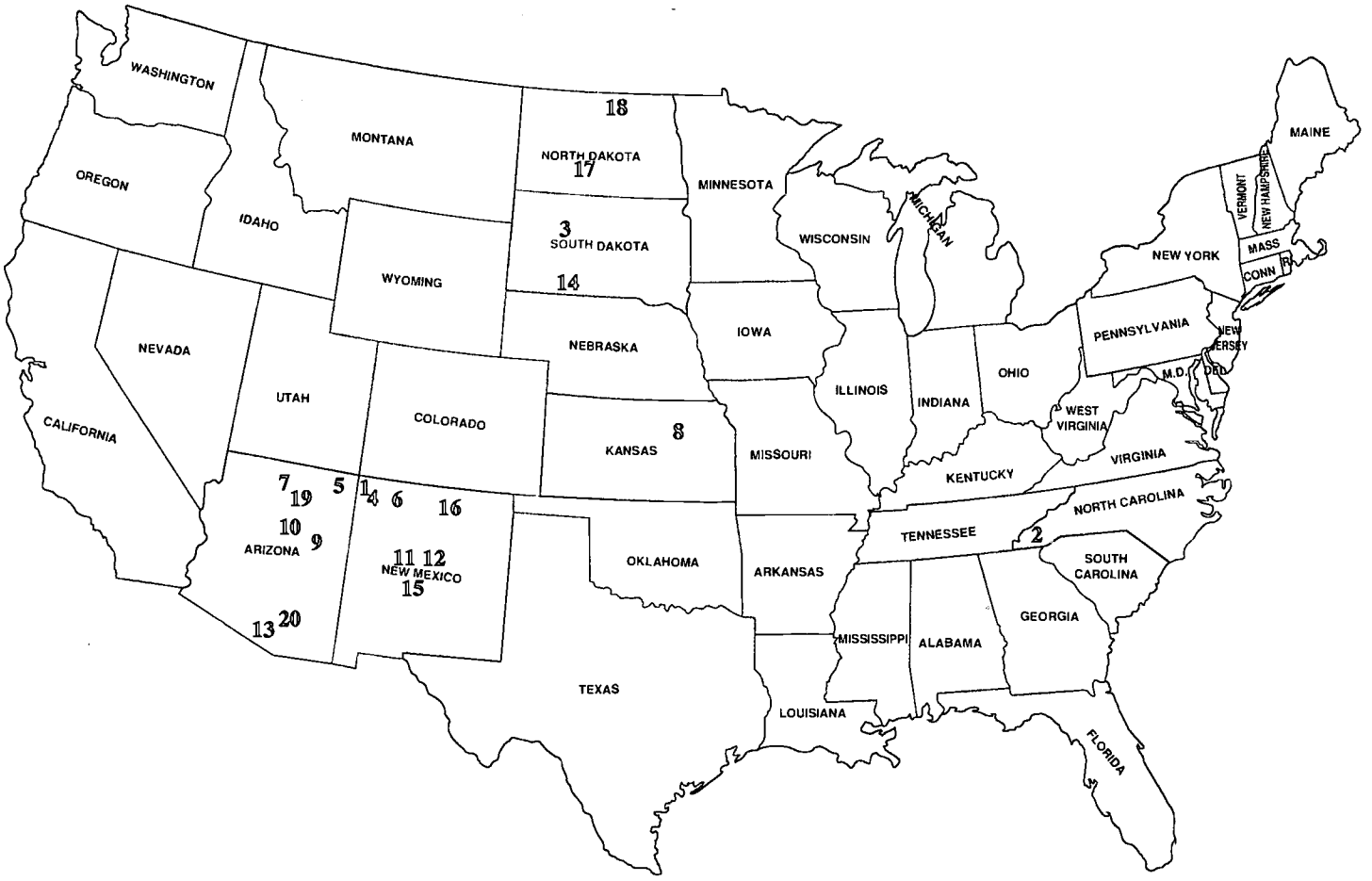

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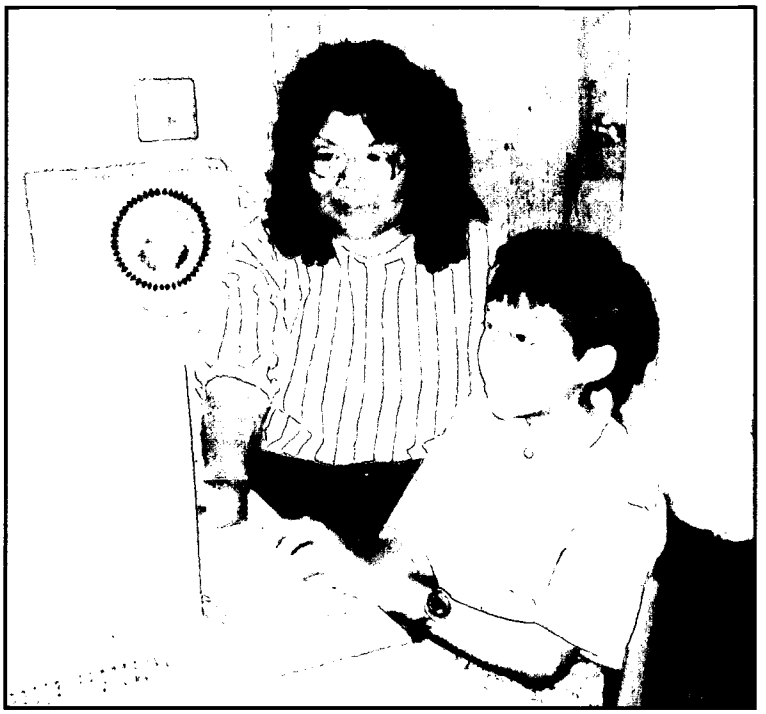
1.
BECLABITO DAY SCHOOL
Shiprock, New Mexico
"Computer Home Improvement Reading Program"

Beclabito Day School is located approximately fifty miles west of Farmington, New Mexico on the Navajo Indian Reservation. The school was established by the Bureau of Indian Affairs in 1935, and remains a BIA-operated school serving 102 students in grades K-4 under the direction of Mr. Daniel Sosnowski, Principal.

The purpose of the "Computer Home Improvement Reading Program," or "CHIRP," which was established during the 1989-90 academic year, is to use computers and software in the home environment to improve reading skills. Home computers, available year around, provide students with additional academic activities to improve reading skills and computer literacy.



Mrs. Barbara Platero, Education Aide/Home Liaison, is giving help to Brian Nakai.

Area schools to which Beclabito Day School students transfer also use computer-assisted instruction. Thus, the student's mastery of basic computer skills in "CHIRP" is important preparation for a successful program at these schools.

The two primary goals of the program include the following:

(1) To allow all students and families access to academic activities outside the classroom by having a computer at home; and,

(2) To increase parent participation in their child's education by reinforcing the parents as the first teachers.

CHIRP is an important supplemental instructional tool for achieving the program's goals. The CHIRP staff, with the help of classroom teachers, attempt to provide programs which address needs identified by the students' diagnostic test results and teacher observations.

The entire teaching staff of six teachers and one aide are involved with strong support from the principal. The Home Computer Liaison is directly involved in the day-to-day management of the program. Classroom and special projects teachers are requested to provide Individualized Education Plans (IEP's), and Student Needs Statements upon which the selection of individual programs are based.

Programs are both lesson specific and topical.

Lesson specific programs, such as the Beclabito Day School Spelling Program, permit students to use the same materials on the home computers that they use in the classroom. Topical programs, such as Word Blaster and Word Match, emphasize vocabulary, structural analysis and reading, and do not duplicate classroom materials.

Particular attention is given to assisting parents in mastering computer skills which allow them to assist and participate in their child's use of the computer. This assistance is given during home visits and by encouraging parents to visit the school for computer training. The CHIRP staff have logged 5,160 miles, 521 hours and 395 home visits during the 1993-94 school year.

In addition, younger siblings of CHIRP students, who will soon attend Beclabito Day School, are taught through discovery learning and are encouraged to use the computer. This helps prevent future reading difficulties among Beclabito students. To facilitate independent reading, students receive two magazine subscriptions and parents receive one magazine subscription per month. In addition, approximately forty homes receive a daily newspaper.

Also, older siblings attending surrounding BIA and Public schools benefit from CHIRP. The school staff has estimated that approximately nine students attending Teecnospos Boarding School in grades five to eight have had access to a home computer. Likewise, nearly thirty-four students in grades five through twelve attending Shiprock Public School also have access to a home computer, which otherwise would not have been available.

The educational benefits to students participating in the CHIRPS' Program are twofold:

(1) To marshal the home environment to improve the reading skills of current CHIRP students and prevent future reading problems; and,

(2) To increase parent involvement in the school.

The estimated cost to start the "Computer Home Improvement Reading Program" was approximately $65,750.00. This cost included the purchase of seventy-five (75) computers, the salary of an Education Aide/Liaison; consultant fees; software and supplies; and travel expenses.

Josephine Doctor on computer reviewing her spelling words. Brandon Todacheenie enjoys working on new lessons on the computer.

For further information you may write or call:

Mr. Dan Sosnowski
Principal
Beclabito Day School
Bureau of Indian Affairs
P.O. Box 1146
Shiprock, New Mexico 87420
(602) 656-3555

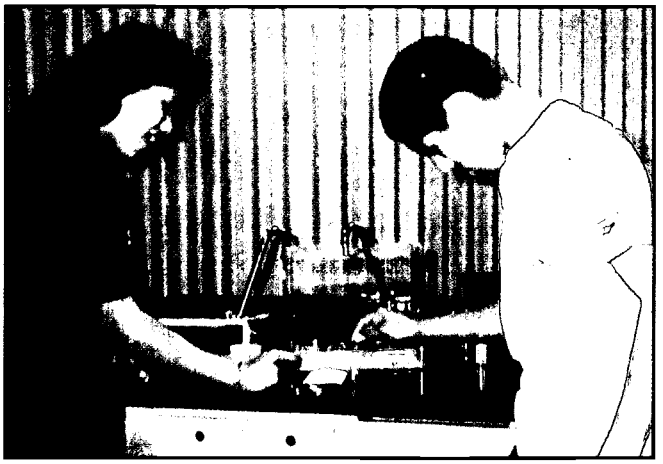
2.

CHEROKEE CENTRAL HIGH SCHOOL

Cherokee, North Carolina

"Cherokee High School Science: Honoring Tradition/Seeking the Future

Students Dawnena Bradley (left) and Devona Pheasant (right) analyze salicyclic acid extracted from willow bark.



Students Joey Sadongei (left) and Charles West (right) apply dye for chromatographic separation.

Cherokee Central High School is located in Cherokee, North Carolina in the "Great Smoky Mountains" of the Cherokee Indian Reservation. Although established by the Bureau of Indian Affairs in 1954, Cherokee Central High School has been a Bureau of Indian Affairs Contract School since 1990. The primary tribe served by the school is the Eastern Band of Cherokee Indians, with a student population of two-hundred forty (240). Forty-two teachers are employed at the school and nine teacher aides.

The "Cherokee High School Science: Honoring Tradition/Seeking the Future" program was initiated under the current format in 1992. All students in grades 9-12 participate in the program which is managed directly by two teachers.

The five goals of the program include the following:

(1) To provide students the scientific literacy necessary to be informed citizens;

(2) To demonstrate cultural relevance to science;

(3) To show practical applications of science;

(4) To encourage curiosity and a sense of wonder; and,

(5) To develop higher order thinking skills.

The science program at Cherokee High School, or CHS, features a high degree of hands-on activities and inclusion of culturally relevant material. All students study physical science and biology. Approximately 45% of juniors and seniors elect to take advanced classes such as advanced biology, chemistry and physics.

Laboratory activities are an essential part of the CHS program. Students spend 30-40% of their time participating in lab work. This is well above the national average of 18 percent. In addition, surveys conducted in 1992 by the National Science Teachers Association indicated that 50% of the country's 9th graders and 46% of 11th graders had done no lab activities. The CHS program philosophy recognizes the need to learn process skills, as well as content material, if the students are to be competitive in an increasingly technological world.

This emphasis on "hands on" learning has had a positive impact on student achievement. Science students take state end-of-course exams available in physical science, biology, chemistry, and physics. While students do not receive a passing or failing grade on the exams, the state predicts each student's course grade based on exam performance. Ninety percent of CHS students who passed their science classes received a predicted passing grade, based on test scores. Also, the CHS average on the state exams is approximately fifteen percent higher than the average for Native American students in state schools.

In addition to lab-intensive instruction, inclusion of culturally relevant material contributes to the success of the science program. Numbers and words in the

Cherokee language are included in many class activities. Some labs have been specially adapted to be more culturally inclusive.

Six representative class and lab activities include the following: (1) Environmental Studies; (2) Separation of Native Dyes; (3) Medicinal Plants; (4) Physics of Traditional Sports; (5) Plant & Animal Studies and Genetics; and, (6) Tools as Simple Machines.

(1) **Environmental Studies:** Advanced biology and chemistry students apply their lab skills to studying their immediate environment. Chemistry students analyze river and well water samples for phosphates and nitrates, using a spectrophotometer for calorimetric analysis. A standard curve is prepared with a computer graphing program; the concentration of chemicals present in the water samples can be determined from the curve. Advanced biology students collect river and pond samples for analysis as well. The health of the water samples can be determined by analyzing the diversity of animal life. Quadrant studies are conducted near the high school to collect additional environmental data. From the quadrant information tables, charts and graphs are compiled which show the variety of plants and animals in the local area.

(2) **Separation of Native Dyes:** Separation of black ink into its component colors is a common activity in physical science classes. At CHS, this activity was modified to include separation of walnut, bloodroot, and yellowroot dyes used in basket making. The results were part of a display at the Cherokee Fall Festival.

(3) **Medicinal Plants:** Physical science students separate salicyclic acid (i.e., used to make aspirin) from willow bark and perform tests to demonstrate that the substance is identical to that used to make commercial aspirin. Traditional use of willow bark and other plants is discussed in class. Biology students collect, press, and mount specimens of plants used in traditional medicine. Modern uses of the plant are also discussed. Student displays were also exhibited at the Cherokee Fall Festival.

(4) **Physics of Traditional Sports:** Sports are frequently discussed in physical science and physics classes because they are filled with examples related to motion. Newton's Laws of Motion are easily applied to stickball and blowguns. Blowguns and archery are related to projectile motion.

(5) **Plant and Animal Studies:** Biology students use the Cherokee language when they study the plant and animal kingdoms. Students are responsible for supplying the Cherokee names for several examples. The habitats and behaviors of local animals are emphasized.

(6) **Genetics:** Study of family trees is addressed when biology students study genetics. Students also research the frequency of diabetes in their families so they can predict the trait for themselves or their offspring.

(7) **Tools as Simple Machines:** Traditionally used tools serve as good examples of simple machines. Sharpening knives and axe blades is related to increasing the mechanical advantage of the tools.

Cherokee High School received a $500 mini-grant from the Chemical Manufacturers' Association in 1992, and a $9,500 TAPESTRY ("Toyota Appreciation Program for Excellence in Science Teachers Reaching Youth") grant in 1994, for integrating culture into science activities. A portion of the grant will be used to establish a museum of science and culture at the high school. During the summer of 1994, culturally relevant labs and other curriculum materials were developed and field-tested for use in the fall as part of the grant activities.

The five major educational benefits to Cherokee students participating in this program are as follows:

(1) Students improve process skills by doing hands-on activities;

(2) Students appreciate the impact of their culture on science;

(3) Students develop higher order thinking skills, such as problem solving;

(4) Students are able to make informed decisions, such as voting on environmental issues; and,

(5) Students develop and retain an interest in science.

No additional costs were incurred, since all program activities were included as part of the high school science curriculum, including the purchase of materials, equipment, books and supplemental materials, and teacher salaries.

For further information regarding the "Honoring Tradition/Seeking the Future" science program, please write or call:

Ms. Lisa Bacon
High School Science Teacher
Cherokee High School
P.O. Box 134
Cherokee, N.C. 28719
(704) 497-5511

3.
CHEYENNE-EAGLE BUTTE SCHOOL
Eagle Butte, South Dakota
"Making Connections"

As part of a math and science unit on measurement, students in Mrs. Donner's fourth grade classroom built their own balance scales, then measured the mass and density of many different substances. Pictured with their team-built scale are Edward Bilbo and Lonna Baumeister.

As part of a water quality unit in grade six, Mr. Schmitz explains the use of a microscope for looking at one-celled animals and bacteria. Pictured are: Mr. Mark Schmitz, teacher; Nick Demarce, Wambli Charging Eagle, Martin Chasing Hawk, Robyn Coleman and Marlene Cook. These students collected water samples and tested several aspects of water quality in this integrated unit.

Cheyenne-Eagle Butte Schools are located in Eagle Butte, South Dakota, where they serve the educational needs of approximately 1,350 students in grades K-12. The majority of students are enrolled members of the Cheyenne River Sioux Tribe of South Dakota.

The Cheyenne-Eagle Butte School was established in 1959 and is a combined school between the Bureau of Indian Affairs and the Eagle Butte School District 20-1. The combined school employs 95 teachers and 35 teacher aides.

The "Making Connections" program was a result of a curriculum revision project directed by the Curriculum Director via a grant received in 1992 from the National Science Foundation, NSF-SSI, through the local school district.

The three goals of the program include the following:

(1) To revise the science and math curriculum so that the students learn to problem solve, experiment, collect data and communicate effectively;

(2) To provide staff development opportunities to teachers in Science and Math areas; and,

(3) To involve parents and community members in student education.

Cheyenne-Eagle Butte school administrators and staff have a high regard for quality education. Their up-to-date ideas help the entire school to forge ahead toward the twenty-first century, staying current in trends for teaching science, math, and technology. Administrators have pursued various grant sources to help finance the initial costs of changing the math and science education program at the school. Along with the grants, in-kind support from the school and the community have been tremendous.

The "Making Connections" project was created at C-EB when the teachers and administrators began pursuing a system-wide change in mathe-

matics and science education — connecting subject matter to daily activities, families to teachers, pupils to parents, educators to other educators, and ultimately, connecting Cheyenne-Eagle Butte students to a brighter future. Below is an outline of current practices at Cheyenne-Eagle Butte that demonstrate an excellent science and math program. The purpose of this plan is to sustain this excellence and to strive for further improvement.

The elementary staff at Cheyenne Eagle Butte School have found that teaching mathematics through the use of manipulative and authentic activities to be a successful approach to teaching math, and of integrating the mathematics and science curricula. First grade students learn to check the weather, report the weather conditions and read thermometers. They also graph the daily temperature and keep track of wind directions for one quarter. On a daily basis, they relate the math they learn in the classroom to activities outside the classroom. This same type of teaching is prevalent in all kindergarten through third grade classrooms. In grade three, students relate the learning of patterns to patterns of nature, the seasons, and schedules.

In fourth through sixth grades, students use the calculator on a regular basis. Calculator lessons are structured so the calculator is a tool for teaching thinking and estimating skills, and of introducing new topics to students in a nonthreatening way. One fifth grade activity that demonstrates this allows students to look through sales flyers for ten items they feel they want to buy, to write down the items and amounts, total the amounts, and then figure the tax they would have to pay in different cities. They add the decimal numbers without the calculator, and check with a calculator, then learn to figure tax using the calculator. Discussion of the difference in taxes from one place to another, and reasons for buying items at different places complete an excellent lesson. This lesson, like many other authentic task activities piloted in classrooms over the last two years, was edited, and a plan for the lesson was written out and included in the curriculum activities booklet for that grade level.

Throughout the fourth, fifth and sixth grades, the correct use of measurement tools has been a goal of teachers for their students. To strive toward mastery, many activities have been developed to give students real practice in these areas. Along with measuring a 24.4 cm line in the math book with a ruler, students have been asked to make scale model drawings of their classrooms, then rearrange the furniture as they like, putting each piece of furniture in scale. The application of this is that each team's drawing be tried out for a week. This sometimes is a bit humorous, but usually gives the student an even better idea of how important a scale drawing can be. Other students are asked to make three dimensional dioramas, starting by measuring out the "environment" (the box). Paper that is measured incorrectly makes a very poor box, as some student teams found out when they forgot to use the meter stick, and had a trapezoidal figure instead of a rectangular one. The second time around for them was much more successful. Again, the teacher plans for these activities are written and distributed to all appropriate staff. The science and math facilitator is in charge of the editing and distributing of lessons and materials.

Students in a special studies science class at Junior High level had an exciting experience this spring. They spent the first three weeks of the quarter learning about archaeology, and the last six weeks participating in an in-class dig. The science and math instructors at that level worked as a team to develop an integrated unit where students could actually dig up artifacts. First, the Industrial Technology class built the dig boxes for each team. Then, the instructors collected artifacts and buried them throughout the 4'x4'x4' boxes. Students worked as teams, using authentic tools and archaeological methods, to uncover each of 20 artifacts. As they began to uncover one they would chart its depth and the coordinates at which it was found. Students and teachers learned much

from this unit. Units such as this are being written and planned for next year. Two units that will be taught are: "Prairie Dogs on the Cheyenne River Reservation," and "Water Quality of Water from Different Sources." The first unit looks at small animal habitats, destructive habits, and other issues dealing with these small rodents. The second unit looks at stock pond water, river water, and water upstream and downstream from the local sewage treatment plant. Plans for this hands-on High School Biology unit include testing for phosphates, nitrates, oxygen demand, live organisms in the water, pH, and turbidity.

Toward connecting students and parents, "Family Math Nights" are held the first and third Mondays of each month throughout the school year. These one and one-half hour sessions of math activities allow parents to work with their children on math concepts, and give parents tips for working with their children on math at home. These sessions, along with "Parent Jamboree Nights," where science and computer activities are presented in the same format, help parents to become more involved with education.

As well as teaching students through hands-on methods and inquiry-based approaches in math, science and technology, the Cheyenne-Eagle Butte School administration believes in offering professional development to the staff for continued learning of new approaches and techniques that can subsequently improve teaching and learning in the classroom. Over the past five years, the school has introduced in-service instruction on cooperative learning; effective classroom management; learning and teaching styles; teaching mathematics using manipulates, authentic tasks and calculators; writing and teaching an integrated unit with a science focus; and Science Manipulative in the Learning Environment — teaching science process skills effectively. As well, Cheyenne Eagle Butte School has begun strategic planning for an improved school and community, and intends to continue this planning process for the next few years. Part of this plan will include a three day in-service training for teachers next fall with workshops focusing upon the alternative methods assessment creating portfolios.

We feel that the science and math program at Cheyenne Eagle Butte is a strong one, and that it will continue to become stronger as we strive for continued excellence. Goals for the future include increasing the number of students enrolled in math and science at the high school level, and encouraging more students to enroll in science or mathematics programs at college or technical schools.

The five major educational benefits to the Cheyenne-Eagle Butte students participating in this program are as follows:

(1) Students gain hands-on experience with exploration science;

(2) Students use calculators and computers efficiently;

(3) All teachers have plans and material to teach hands-on lessons;

(4) Students are able to learn math using manipulatives; and,

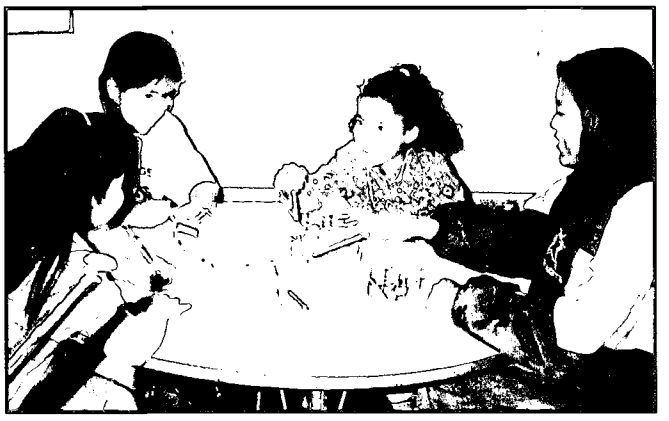
(5) Teachers learn to write and teach units that integrate subject matter including language arts, science and mathematics.

The cost required to start the "Making Connections" program was approximately $70,000 provided from a variety of sources. The funds were utilized for teacher and facilitator salaries, computers, calculators, staff development, travel and expenses for student field studies and supplies for hands-on activities.

For further information regarding the Cheyenne-Eagle Butte "Making Connections" math and science program, please write or call:

Ms. Cora Cook
Science Teacher
Cheyenne-Eagle Butte Schools
P.O. Box 672
Eagle Butte, SD 57625
(605) 964-7920

4.
COVE DAY SCHOOL
Shiprock, New Mexico
"Effective Math and Science Strategies on the Navajo Reservation"



Students are investigating the number of edges, faces and vertices. Clay was used for the vertices this time, but more fun and math opportunities can be had with edibles. There are bound to be leftovers. Gumdrops, raisins, marshmallows or popcorn all work well.

Cove Day School is located approximately forty-five miles southwest of Shiprock, New Mexico. The school was established by the Bureau of Indian Affairs in 1959, and remains a BIA-operated school which serves seventy-seven (77) students in grades K-6 under the direction of Ms. Rena Yazzie, Principal.

Two teachers, Ms. Theresa Smith and Ms. Patricia Linseisen are responsible for developing math and science programs they feel especially meet the needs of their students.

Ms. Smith, a second year teacher, came to Cove Day School from a large metropolitan school district where she had access to current math and science curricula and actively participates in many workshops, conferences and classes to keep abreast of the latest in math and science.

Ms. Linseisen is beginning her seventh year at Cove Day School after having taught in many parts of the country as well as overseas as part of the Department of Defense School Program. She teaches grades 4-6 and also attends workshops and continuing education courses to constantly improve her skills.

In the fall of 1993, Cove Day School teachers saw the need to focus on math and science.

The four primary goals of the program include the following:

(1) To provide math and science classes which are culturally relevant;

(2) To provide hands-on math and science in accordance with the uniqueness of the community and its culture;

(3) To develop a high interest level in problem solving; and,

(4) To assure a wide variety of meaningful skills and experiences using math and science foundations.

In grades third and fourth the instructional unit focuses on making the lessons culturally relevant to its Navajo students. Therefore, the lessons are based on the beliefs of the Navajo people, as well as other tribes, thus providing a meaningful context for learning. When integrating culture, the students are to be successful and build a foundation for lifelong learning. The instructional units meet the diverse educational needs of both grade levels and prepares them for intellectual challenges. Therefore, the units incorporate creative thinking, as well as oral and written communication. The process of actually doing science and math is most valuable and enjoyable. For instance, to utilize student knowledge of mathematics, science and technology to solve problems, the following process is used to develop their intellectual skills:

1. Using Manipulatives - Doing
2. Number Abstract - Writing
3. Formula (Abstract Generalizing) - Thinking
4. Graph Representational - Illustrating

As part of the instructional units, students become knowledgeable in different areas such as: aerodynamics, the solar system, the incredible egg, hot air balloons, geological formations and many more. Students find the areas very interesting and exciting.

Ms. Linseisen has subtitled her program, "We Ate Our Math." Students are presented with a

wide array of edible products to reinforce basic and advanced math and science skills. Students begin by estimating in at least five areas. These areas might include length, weight, number, serving sizes, and number of servings in either customary or metric measurement or both. These activities sometimes include converting ounces into pounds, liquid measurements into cups, liters, quarts, and lengths into inches, feet, meters, decimeters and centimeters. Students also learn to make estimates in grams and milliliters. Estimates are written by each student on tags to be placed on poster boards in the appropriate sections. The actual answers are then determined and those with the correct answer or the closest answer place a sticker on their tag. Other estimating activities might include calorie content per serving, main ingredients, and nutritional values. For such round items as cookies, students estimate the radius, circumference and diameter. Students learn to formulate unit pricing and empty boxes become exercises in estimating and determining volume. It is amazing how rapidly students develop the skill to accurately estimate in all areas.

The food products are then used for such activities as counting and averaging, division, including fractional parts, addition, multiplication, subtraction, measuring, recording, graphing, comparing, generalizing, determining ratio and percentage and classifying. Often the activities to be enjoyed are determined by the students.

Once the possibilities are explored, students break into groups to create word problems relevant to the product. Initially, the word problems tend to be rather simple mathematical stories. As the year progresses and confidence grows, each group tries to challenge the other groups with increasingly complex problems involving multifaceted operations. It is during these group sessions that students are enjoying their edibles.

A trip to the grocery store becomes a whole new adventure as students observe various items to try to "second guess" what the teacher will present and improve the accuracy of their estimates. Grocery shopping has certainly taken on a new perspective for the teacher as she notices how many different geometric shapes are contained in cracker boxes or the ways "Gummi" creatures can be sorted according to scientific classifications.

The educational benefits to students attending Cove Day School are as follows:

(1) Students are able to read food labels and interpret their meaning;

(2) Students are able to compare cost of food and other items they purchase;

(3) Students are able to read and follow directions;

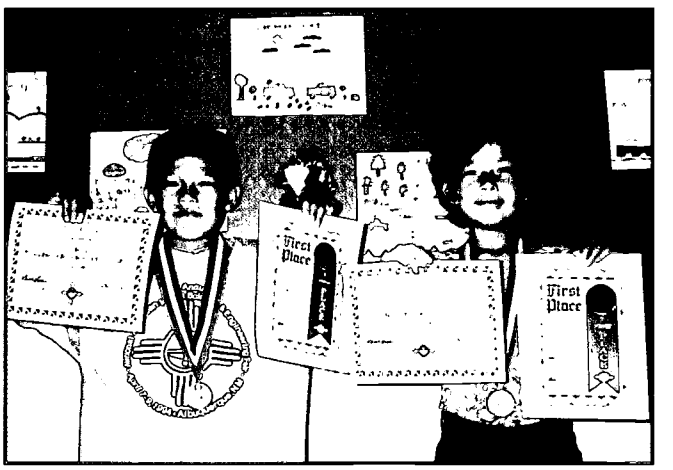
(4) Students are able to measure, compare, and analyze; and,

(5) Students are able to converse using these skills.

The only additional program costs were the cost of ingredients in the "We Ate Our Math" program.

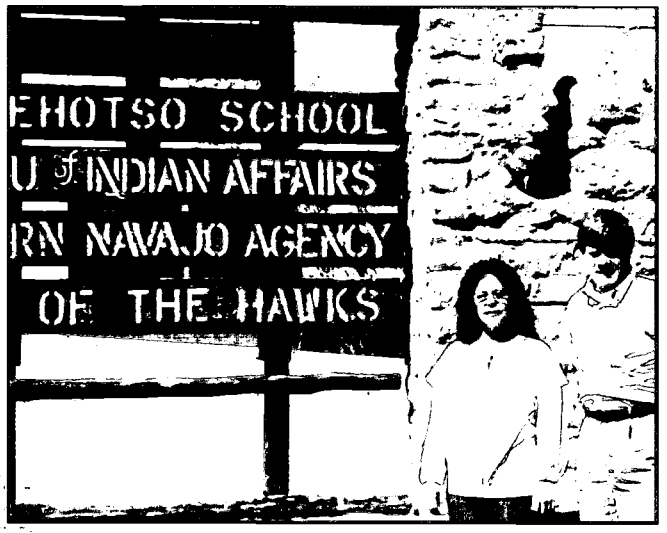
For further information you may write or call:

Ms. Rena Yazzie
Principal
Cove Day School
P.O. Box 3537
Shiprock, New Mexico 87420
(602) 653-4457



The two third graders, Travin Thompson and Cortina Yellowhorse, participated in the agency-wide science fair and received first place on their project. Also, they participated in the New Mexico State American Indian Science and Engineering Fair and received first place in the Team Project category. Their project was in the area of Aerodynamics (Title: Can We Better Design a Paper Airplane?) This was the first time any student had ever received these awards at Cove Day School.

5.
DENNEHOTSO BOARDING SCHOOL
Dennehotso, Arizona
"Dennehotso Boarding School Library-Media Center"



Principal Velma Eisenberger and Media Center Coordinator Pat Carr pose outside the school. Eisenberger was the Arizona Educational Media Association "Administrator" of the Year (1992) and Pat Carr was NASBA " Teacher of the Year" (1993) because of their utilization and advocacy for the use of technology in education.

TINY TECHIES. Desi Rae Littleman, 6, a kindergarten student at Dennehotso demonstrates the power of technology to her father Raymond Littleman. At Dennehotso, computers are found in all K-8 classes and are accessible to the parents for training after school and on weekends.

Dennehotso Boarding School is located in Dennehotso, Arizona, on the Navajo Indian Reservation in the rural, high desert country of Northern Arizona. The school is situated 110 miles west of Farmington, New Mexico and 25 miles east of Kayenta, Arizona. It was established in 1932 and is operated by the Bureau of Indian Affairs.

However, the "Dennehotso Boarding School Library-Media Center" program began in 1989. Currently, one school administrator and fourteen teachers provide educational services to three hundred twenty (320) primarily Navajo students in grades K-8.

According to the 1990 U.S. Census, the family income for the community served by the school is $3,111. Sixty-seven percent (67%) of the households live below the federal poverty level.

In the past the school was sensitive to the needs of the ESL learners but was limited to using a traditional didactic approach for instruction with textbooks, workbooks, and lectures. This approach was severely limited and produced little success. Therefore, technologies were added to enhance the teaching and learning process. Parents were involved throughout the process due to the critical role which they play in their children's education, and to address some of their own educational needs and interests. To continue their education in the past parents had to leave their homes and communities for extended periods of time due to the absence of nearby educational facilities. However, now, due to this program, parents may remain at home and continue their education on their own schedules.

The five goals of the program include the following:

(1) To teach English to ESL learners in an exciting and stimulating manner;

(2) To provide educational opportunities to parents and members of the local community using Distance Learning Communications;

(3) To increase school attendance and involvement in school activities;

(4) To enhance learning in basic skills; and,

(5) To motivate students by building their self-

confidence and fostering their creativity.

The two primary objectives of the "Dennehotso Boarding School Library-Media Program" are as follows:

(1) To provide enjoyable learning opportunities for students to learn English as their second language; and,

(2) To provide parents of students opportunities to address their own educational needs and interests via lifelong learning activities.

The use of technology is taught through team teaching methods and cooperative learning techniques. Students are provided training in their library classes. Staff in-service training is provided directly to the teachers in their respective classrooms, or at the University of Phoenix, Phoenix, Arizona. The successful use of technology at the school is not dependent upon a "technology guru," since the entire staff are encouraged to use the technology and supportive instructional media.

In order to address the objectives identified above, a variety of technologies are utilized. In selecting the technologies, primary consideration was given to those that were user-friendly, including the following: sixty-six microcomputers located throughout the school, more than one hundred and fifty software programs, four Headstart computers with built in CD-ROM's for electronic researching, and Discus Books to improve reading skills, four state of the art multimedia computers, two laser disc players with access to "Windows on Science" and others in both math and science, one satellite TV system, which is the only source of television programming in the community; fifteen TV/VCRS, four camcorders, three robotics kits, and access to Internet via ENAN. Most of the video materials are used with closed-captions to facilitate the learning of English.

In addition, in cooperation with a consortium of other schools in the State of Arizona, the students have access to an additional fifty (50) instructional television courses in art, music, math, science and others to supplement and enrich regular classroom offerings.

Since initiating this program there has been an increase in student attendance. And according to a recent school evaluator, the technologies utilized are making a substantial difference in the improvement of student learning.

In addition, parents are more involved in the education of their children. Parents have enrolled in basic English classes and lower division college courses through Distance Learning Services provided by Northland Pioneer College, Rio Solado Community College and at the University of Arizona. These classes are delivered by telephone, or by conventional correspondence course fashion using audio and video tapes. Some of the parents are working on their General Education Diplomas (GEDs), via video tapes provided by this program.

The promise and potential of technology to provide exciting learning opportunities for Navajo ESL students and viable lifelong learning opportunities for their parents is being realized at Dennehotso Boarding School. What had been a bleak and dismal situation for academic success in the past is now a springboard of hope and opportunity, thanks to the benefits of effective use of a wide variety of technology.

The five major educational benefits to students participating in the program include the following:

(1) Students use exciting computer programs designed for learning;

(2) Learning is fun;

(3) Parents are also students and a source of inspiration;

(4) Students can learn with and from each other; and,

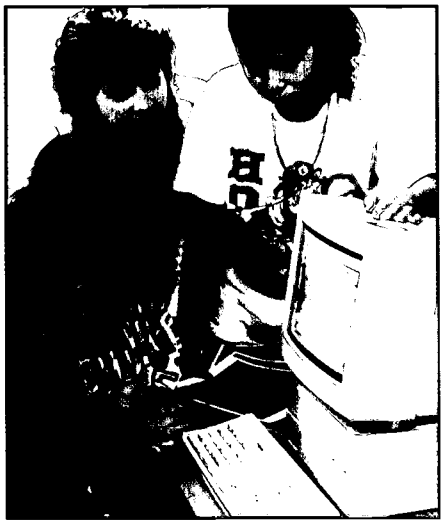
(5) The school now has a winning attitude and is moving positively toward the 21st Century.

The cost of establishing the program is provided by a Title VII Grant of approximately $97,500 per year, with supplemental funding from the BIA's "Sharing Excellence Network," the Gifted and Talented Program, Children, Inc., and the regular school program. Major expenses included the following equipment purchases: (1) the satellite T.V.; (2) a decoder for Caption television; (3) the Microcomputer System; (4) the Darome Teleconferencing System for audio classes; and, (5) a modem and telecommunications program.

For further information regarding the "Dennehotso Boarding School Library-Media Center Program," please call or write:

Mr. Pat Carr
Elementary Library Science Teacher
Dennehotso Boarding School
P.O. Box LL
Dennehotso, AZ 86535
(602) 658-3201

6.
Dzilth-NA-Dith-hle Community School
Bloomfield, NM
"Image Processing for Teaching"



8th grade students Marylee Murphy, Sonya Sandoval, and Carletta Yazzie are observed by Mrs. Siedlecki as they select a variation of an image of a world map to use in completing an assignment.

The Dzilth-Na-O-Dith-Hle Community School is located twenty-six miles south of Bloomfield, New Mexico on the Navajo Indian Reservation. The school was established by the Bureau of Indian Affairs in 1968 and remains BIA-operated today. Eighteen teachers and twelve teacher aides are employed at the school which serves the educational needs of approximately 360 Navajo students in grades K-8. However, it also provides a boarding school for nineteen (19) students in grades 9-12.

The "Image Processing for Teaching" program was begun in July, 1991. The Junior High mathematics teacher manages the program on behalf of eighty-five (85) Navajo students enrolled in the sixth, seventh, and eighth grades who participate.

The six goals of the "Image Processing for Teaching" program include the following:

(1) To provide a discovery of learning and problem solving environment in which students work cooperatively while engaged in critical thinking;

(2) To provide a student-directed learning environment in which the student can take some ownership in the learning process;

(3) To provide activities which empower the students to investigate interdisciplinary skills which are relevant to real-world applications;

(4) To provide hands-on visual learning experiences through the use of digital imaging as an alternative to traditional language-based teaching;

(5) To provide an opportunity for students to experience a technology application which has in the past only been available to people in the fields of medicine and science; and,

(6) To provide a career education insight for students to see the use of digital imagery in a variety of careers, including various science disciplines, journalism, and the movie industry.

The "Image Processing for Teaching" program involves the sixth, seventh, and eighth graders in their math classrooms. The students use computers to do digital image processing. The math teacher originally became involved with this technology through the Image Processing for Teaching project at the University of Arizona during a four-week training program in July, 1991.

Image Processing for Teaching (IPT) uses digital image processing on classroom microcomputers to provide a powerful medium for exciting students about science and mathematics. Visual learners and others whose needs have not been met by traditional language and math-based ways of introducing these subjects are especially impressed by this approach. IPT leads students and their teachers into exploration and discovery using original data sets and state-of-the-art research tools. The pilot phase of the IPT project, from 1990 to 1992, was funded by the National Science Foundation and Apple Computer. Participating schools spanned a diversity of student bodies, types of schools, and geographical settings. Classroom success in the experimental phase of the project has led to widespread demand for in-service teacher education, and the IPT project has responded by providing a five-day in-service workshop for presentation to teachers at their home schools.

The objective of the workshop is to educate teachers in the technique and technology of image processing, and in the scientific content of a variety of data sets. Teachers are developing classroom activities for children in a wide range of grade and subject areas. For instance, teachers and their students work with systems consisting of a Macintosh II or LC computer with a CD-ROM drive, the NIH Image software and extensive data sets of imagery, including biomedicine, planetary exploration, astronomy, environmental science, geography, mathematics and meteorology.

Digital Image Processing is the technology that allows scientists to manipulate images in order to bring out features and properties that have been previously difficult or impossible to perceive. This technology is used by scientists to enhance images relayed to earth in digital form from interplanetary space missions and weather satellites. The process is also used by doctors to manipulate images generated during CAT scans and magnetic resonance imaging sessions. Today, image processing is an important

tool in many major areas of scientific study. This new technology has now advanced to the point where sophisticated systems are available for microcomputers. Students use image processing to manipulate digital images through a computer using NIH Image, which is public domain software developed by the National Institutes of Health.

The students are also involved in their own image acquisition through the use of a video camera and digitizer, so they may explore areas of interest to them. An example of this is an investigation of geometry in the real world of the students' local environment. Students have studied symmetry using images of each others faces, photos, and pets. Another creative use of image processing is studying motion by using animated video frames, for example, a bicycle traveling down the street, an animal running, a bird flying, or a runner on the track. Using the capabilities of the software, students can do on-screen measurements and analysis of the movement. Using weather satellite data students can animate the movement of a hurricane and predict and calculate its speed. The students become quite involved in these projects because they have ownership in the creation of the activity.

Image processing activities are a natural way to general interdisciplinary connections. For example, students in the math class are studying geometry, scaling, set theory, matrices, statistics, graphing, and other areas with activities that are motivated by, and applicable to, real world phenomena using scientific imagery. English teachers can use IPT as a focus for writing projects, and the opportunities for application to science and social studies are limitless. Starting by playing around with manipulating the pixels of an image, students become familiar with coordinate systems, numerical arrays, scale, histograms, lookup tables, and other processes involved. More advanced students delve into the technical details of the software and quantitative analysis.

7th Grade students Angelissa Smith, Archie Yazzie, Gavin Werito, Jones Charley check data from the data table in the image processing software after completing a measurement.

At Dzilth-Na-O-Dith-Hle School the students use four Macintosh computers in the math classroom to do image processing. They form small groups and work cooperatively two days a week. The image processing activities coordinate well with current curriculum goals already established by the National Council of Teachers of Math, or NCTM standards. They allow for hands-on reinforcement of skills and provide a real world connection that makes school work so much more meaningful to students.

The five major educational benefits to Navajo students participating in the program include the following:

(1) At-risk, under-motivated students have demonstrated excitement through participation in image processing activities;

(2) With image processing activities, students integrate math, language, social studies and science skills;

(3) Through the involvement with the scientists and other professionals at the Image Processing for Teaching program, students have had access to scientific imagery and have been able to study and manipulate the data in a way that would not have been possible in the classroom without this technology;

(4) Students can use a camera and video digitizer to acquire their own images to investigate a question of particular interest to them; and,

(5) Students are becoming more computer and technology literate which will benefit them in their ongoing schooling and in the progressive job market.

The "Image Processing for Teaching" program was initiated at no expense as a fully funded pilot project. However, the costs to start a new program are approximately $3,500. One color Macintosh LC computer with 4 MB of RAM and a CD-ROM reader with a price tag of $2,500 is required. Optional hardware is needed, including a video camera, video digitizer and VCR. And, workshop training for learning to implement the National Institutes of Health, (NIH) Image software must be undertaken. The cost for such training is $1,000 per student to travel to a summer workshop, or $8,000 for the training of sixteen (16) teachers at a district workshop.

For further information regarding the Dzilth-Na-O-Dith-Hle School "Image Processing for Teaching" program, please write or call:

Ms. Deborah Siedlecki
Junior High School Math Teacher
Dzilth-Na-O-Dith-Hle School
P.O. Box 5003, St. Rt. 4
Bloomfield, NM 87413
(505) 632-1697

7.
GREYHILLS ACADEMY HIGH SCHOOL
Tuba City, Arizona
"Radio Broadcasting Program"

The Greyhills Academy High School is located in Tuba City, Arizona approximately seventy-five miles north of Flagstaff, Arizona on the Navajo Indian Reservation. The school was established by the Bureau of Indian Affairs in 1973, and is today a BIA Grant school which serves approximately two hundred seventy (270) students in grades 9-12 under the direction of Dr. Harold Begay, Principal.

The purpose of the Greyhills Academy High School Radio Program is to provide training in radio broadcasting to approximately twenty-six (26) Navajo and Hopi students in grades 9-12.

The four major goals of the program include the following:

(1) To demonstrate an understanding of the practices, procedures, routines, and techniques employed in the Radio Broadcasting industry;

(2) To exhibit program competencies and apply gained knowledge of the radio industry for entry level employment or further radio training;

(3) To demonstrate an ability to perform routine production and studio operations; and,

(4) To justify and support the relationship between the four major areas in a radio station: engineering, management, sales and programming.

The Radio Broadcasting Program has grown into a highly developed, greatly respected, one-of-a-kind program originated by Mr. Stu Shader, the Radio Broadcasting instructor. KGHR is one of the nation's only Native American high school radio stations.

Student Debralee Johnson (DeeJay)

The program includes the development of a course of study for radio broadcasting, including the following seven elements: (1) units of instruction; (2) detailed teaching plans; (3) teacher demonstrations; (4) supplemental materials; (5) written instruction sheets; (6) instructional analysis; and, (7) education goals for each unit.

The following is a brief outline of the seventeen units of instruction included in the program: (1) the history of radio; (2) the microphone; (3) tape machines; (4) reel-to-reel machines; (5) cassette machines; (6) cart machines; (7) digital audio tape machines; (8) audio tape; (9) compact disc players; (10) the console; (11) writing for

radio; (12) operations; (13) promotions in radio; (14) jobs in radio; (15) announcing skills; (16) job skills and performance; and, (17) radio formats. As a result of these units, students have demonstrated an understanding and acquired competencies in radio practices, procedures, routines and techniques.

The students have successfully applied their knowledge and skill in operating their own radio station, KGHR. They have performed duties in an educational environment that develops professionalism and prepares them for entry level employment or further broadcasting training. The students have also participated in radio club, promoting a concert, public speaking, and in developing a newsletter about radio station KGHR entitled, "Radio Flyer." Recently, they visited a Navajo Chapter House and spoke to the planning committee regarding the need for KGHR to have a billboard for the purpose of advertising.

This year has been an exciting year for radio students because they have received recognition locally, regionally and nationally. However, future plans include the acquisition of satellite equipment in June, 1994 for the purpose of down-linking programs from the American Indian Radio on Satellite, AIROS. Then students and community broadcasters will begin broadcasting Native American programs from around the country. Later, via KGHR, its broadcasters will be able to produce programs to be distributed nationally, via the up-link center in Lincoln, Nebraska. In preparation for program distribution, the students have brainstormed about the types of programs they want to create for up-linking to other Native American radio stations.

The education benefits to students participating in the "Radio Broadcasting Program" include the following:

(1) The enhancement of student communication and thinking skills;

(2) The acquisition of applied academic and technology skills;

(3) The learning of business, economic and collaborative working skills; and,

(4) The students obtain a basic level of knowledge and skills needed to succeed in radio broadcasting, and other related fields.

The estimated cost to start the "Radio Broadcasting Program" was approximately $24,000 for salary, equipment and supplies.

For further information you may write or call:

Mr. Stu Shader
Radio Broadcasting Instructor
Greyhills Academy High School
P.O. Box 160
Tuba City, Arizona 86045
(602) 283-6271

Student Rajean Kootswatewa

8.

HASKELL INDIAN NATIONS UNIVERSITY

Lawrence, Kansas

"Haskell Math and Science Summer Workshop"

Ms. Deborah Kent, Ms. Marcella Vaughn and Ms. Nancy Roehl are putting final touches on their curriculum project. Ms. Geraldine Stevens, Ms. Bonnie McGinnis, Mr. John Wray and Mr. Don Yellow Bird enjoy refreshments as they select Native American designs to enhance their lesson plans.

Ms. Nancy Roehl is deeply engrossed in her research as she prepares a lesson plan for the 1993 curriculum text. Mr. Francis Wilson, Mr. Melvin Chico, Ms. Arlene Valenzuela and Mr. Don Yellow Bird are preparing another chart. (See background)

The Haskell Indian Nations University is located in Lawrence, Kansas, where, since 1985, it has hosted the "Haskell Math and Science Summer Workshop" for up to eighty teachers of American Indians in Bureau of Indian Affairs-Funded elementary and secondary schools. The funds are granted by the Department of Education through the Dwight D. Eisenhower Mathematics and Science Education Act.

The three major goals of the program include the following:

(1) To provide basic mathematics and science skills;

(2) To coordinate the basic mathematics and science skills with the proposed National Standards; and,

(3) To develop a culturally relevant curriculum.

During the past two summers, the math and science workshops have attempted to focus on goals identified by the Indian Nations at Risk Task Force, as well as the Indian Student Bill of Rights. According to the Bill of Rights, every American Indian and Alaskan Native is "entitled to a linguistic and cultural environment in a school that offers students opportunities to maintain and develop a firm knowledge base." In accordance with the above directive, the two primary objectives of the Haskell summer workshops are as follows:

(1) To prepare culturally sensitive curriculum materials for elementary teachers in Bureau of Indian Affairs schools to use in the areas of mathematics, science, and natural resources; and,

(2) To better prepare teachers in the areas of curriculum development, selection and evaluation.

While curriculum writing has been the main thrust for the workshops since 1992, each year the emphasis is placed on a different aspect. The focus for 1993 was Natural Resources: water, gas and oil, fish and wildlife, and agriculture. For 1994, the National Mathematics and Science

Standards served as the basis for curriculum writing. The workshop emphasized the training of teachers to utilize creative approaches to teach basic mathematics and science concepts, and enabled teachers to develop instructional units that integrate the National Mathematics and Science Standards with information relevant to American Indian culture and contemporary life.

Elementary teachers in Bureau of Indian Affairs funded schools who are interested in developing culturally relevant and innovative ways to present mathematics and science subject matter to students in kindergarten throughout eighth grade were encouraged to apply for participation in the Haskell workshop. All applicants were required to send in a double-spaced, typewritten essay explaining their reasons for desiring to attend the workshop. A letter of recommendation from a principal, superintendent, or school board member was also requested.

Since curriculum writing is an integral aspect of the workshop, writing ability was an important factor in the selection of participants.

Haskell provides room and board, a stipend, and a travel allowance for each participant. During the 1993 workshop, participants were offered college credit for their participation and were awarded certificates. In Summer 1994, two graduate credits were offered from Adams State College in Colorado.

The workshop staff for the 1993 Workshop consisted of one coordinator, one math facilitator, one science facilitator, an editor, a driver, and a clerk-typist. Staff members were on duty one week before the workshop began, in preparation for the arrival of the workshop participants.

On the first day of the 1993 workshop, group exercises were conducted so the participants could get acquainted with each other, share their expectations of the workshop, and identify topics they would like to see addressed. The activities of getting to know each other and sharing ideas served as a prelude to several weeks of intense, but exciting, workshop involvement.

For the first two weeks of the 1993 workshop, the mornings were spent listening to presentations by the Natural Resources personnel. Some of the presenters conducted hands-on activities and noteworthy demonstrations that the teachers could use to great advantage in their classrooms.

The afternoons of the first two weeks were used for group discussion and in the development of culturally-related teaching materials. Also, Native American styles of teaching and learning, and culturally relevant and tribally specific natural resource and economic development information were shared.

During the last week of the 1993 Workshop, participants concentrated on composing and writing lessons dealing with the four natural resource areas studied, including water, gas and oil, fish and wildlife, and agriculture. On the second to the last day of the conference, all curriculum projects were submitted to a consultant who determined which ones were to be included in the final collection.

The three major educational benefits to participants in the program include the following:

(1) Experience with hands-on activities;

(2) A culturally relevant math and science curriculum book composed by the participants for classroom use; and,

(3) The ability to evaluate, supplement and compose a curriculum so that it is complete, accurate, and culturally relevant.

The participants' evaluation for the "1993 Haskell Math and Science Summer Workshop" was very positive, since 93% of the group indicated that they would recommend it to the other teachers in their schools.

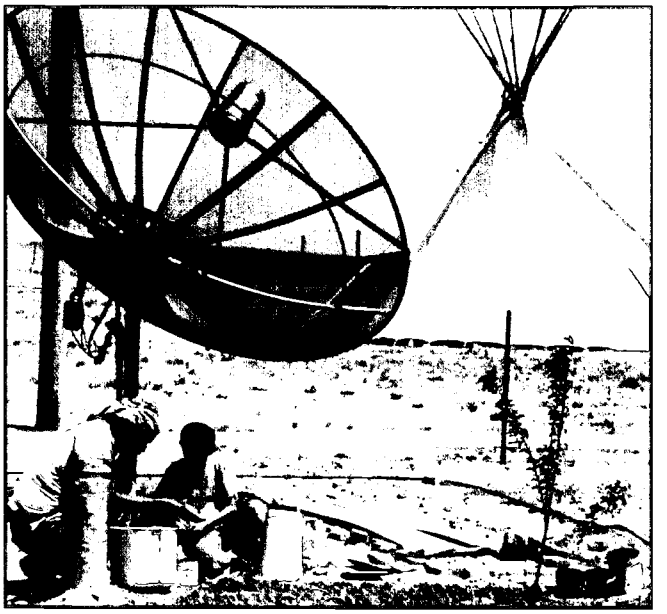
The cost to present the "Haskell Math and Science Summer Workshop" is approximately $140,000 per year, which includes salaries for personnel, participant travel expenses, lodging, meals, and stipends.

For further information regarding the annual "Haskell Math and Science Summer Workshop," please write or call:

Dr. Sharon Atkinson
Summer Math and Science Workshop
Coordinator
Department of Natural and Social Sciences
155 Indian Avenue
Haskell Indian Nations University
Lawrence, KS 66046
(913) 749-8428

9.
LITTLE SINGER COMMUNITY SCHOOL
Winslow, Arizona
"Reclaiming the Desert with Native Plants"

Dr. Mark Sorensen, Principal, and some of his students.



Technology and Tradition: Justin Willie working with Vance Clay planting native seeds using modern drip irrigation.

The Little Singer Community School is located on the Navajo Indian Reservation approximately 51 miles east of Winslow, Arizona. The school was established by community organizers and volunteers from a California college which built the first classrooms in 1976. The first funding was from private wealthy individuals. The School then became a P.L. 93-638 contract school in 1978. However, today, Little Singer Community School is a Bureau of Indian Affairs Grant School, with one administrator, seven teachers and seven teacher aides. Together they serve the educational needs of ninety-seven (97) Navajo students in grades K-6.

The "Reclaiming of the Desert with Native Plants" program began in the summer of 1993 through a recreation program in which students were involved in planting trees. Today, four teachers and all ninety-seven students in grades K-6 participate in the program.

The five educational goals of this program include the following:

(1) To demonstrate an understanding of the process of erosion and desertification;

(2) To participate in the construction of low-tech water collection methods useful in deserts;

(3) To participate in the preparation of unproductive soil for planting of native seeds;

(4) To participate in the planting of gardens and trees on the school campus; and,

(5) To participate in planting self-sustaining small gardens at selected remote home sites on the reservation using water collection techniques learned at the school.

The Little Singer Science Demonstration project, "Reclaiming the Desert with Native Plants," is focused upon teaching the elementary students at Little Singer Community School in northern Arizona ways in which they can use traditional plants and modern drip irrigation technology to prevent further erosion of the desert soil and to make the soil productive for gardens and trees. The school is located on sandy barren soil, as are most of the homes of the children who attend the school. The aim of the program is to teach the children how to make the desert

around the school bloom with plants native to the area using technologies that are simple, effective, and low cost. Then the students may use these same strategies for growing gardens and trees around their own homes.

The soil in this portion of the reservation has been badly eroded by alternating flooding and drying winds and overgrazing by sheep. Seventy percent (70%) of the families in the area served by Little Singer Community School do not have running water, so they have to haul water and often don't have enough water left over for any plants. Until we have demonstrated to the families ways in which they can get plants and trees to grow and prosper without great additional work on their part, it is unlikely that these families will make an effort to use plants and trees to prevent or reverse erosion.

When the students learn how to use native plants and water catchment and drip irrigation technologies, and succeed in making the soil around the school bloom using these technologies, they can apply that knowledge to help reverse erosion around their homes and in the area in general. The Director of the school worked with all the classroom teachers to establish this practical application of science as a priority in their instructional process. Next, they defined the job description of the Community Science Instructor, recruited a knowledgeable individual from the community for that job, and set aside two periods each week in each class for students to participate in the Science Demonstration Project. The first step in the educational process was to have the part-time Community Science Instructor come into the classrooms and teach the children in grades K-6 about the effects of erosion, using simple hands-on kits donated to the school from Northern Arizona University. The second step was to have the Community Science Instructor work with the students to set up rain gutters and 55 gallon water barrels to catch the rain water and snow melt water coming off the roofs of the buildings at the school. The third step involved the Community Science Instructor working with the teachers and students in grades K-6 in preparing the soil with natural mulches (i.e., tree bark) and planting gardens with seeds of plants native to the area. The fourth step involved the teachers and students, led by the Community Science Instructor, in the laying out of the drip lines and the connection of the drip lines to the water barrels. The fifth step involved the maintaining of the plants through the regular watering of the plant using the water catchment system and the drip irrigation lines.

The Little Singer science demonstration project, "Reclaiming the Desert with Native Plants," has been a tremendously successful project at the school and in the community. The students look forward to the time every week that they will spend outside working with the plants. Even in the arid desert climate, the water catchment and drip irrigation technology works extremely well and has provided ample water to the gardens and trees. The entire staff, as well as all the parents who come to visit the school, can see immediately the increased plant growth and are pleasantly surprised by it. Three families who have students in the school, learning of this technology, have invited the students and the Community Science Instructor to visit their remote home sites and establish similar water catchment and drip irrigation systems with native plants. The next step is to work with more families in this way and to make the entire community their science classroom.

The three major educational benefits to Navajo students participating in this program include the following:

(1) Achieving some degree of self-sufficiency by applying simple scientific concepts;

(2) Showing students how to apply their scientific understanding of plants; and,

(3) Demonstrating to students how hands-on science activities at school can impact the health and welfare of their communities.

The cost for the entire year of the project is estimated at $5,000, which includes the salary of one part-time Community Science Instructor, water barrels and gutters, and drip irrigation lines. The trees and seeds are donated by local Navajo families.

For more information regarding the "Reclaiming the Desert with Native Plants" program, please write or call:

Dr. Mark Sorensen
Executive Director
Little Singer School
"Reclaiming the Desert with Native Plants Project"
H.C. 61, P.O. Box 239
Winslow, AZ 86047
(602) 526-6680

10.
NORTHERN ARIZONA UNIVERSITY
Flagstaff, Arizona
"SMILE: Science and Mathematics for Indian Learners and Educators"

The Northern Arizona University, which hosts the "Science and Mathematics for Indian Learners and Educators Workshop," known also as, "SMILE," is located on the NAU campus in Flagstaff, Arizona. This workshop was established in 1992 and has been attended by approximately thirty-five (35) students each summer for the past two summers under the direction of Dr. Carol R. Adkins, Coordinator. The purpose of the workshop is to provide needed skills in the areas of science and mathematics to Indian learners and educators from across the state of Arizona.

The six goals of the workshop include the following:

(1) To understand new approaches to teaching science, mathematics and environmental education;

(2) To understand curriculum development strategies;

(3) To increase the variety of instructional strategies in science and mathematics teaching;

(4) To elevate awareness of resources available for science, mathematics and environmental education instruction;

(5) To adapt commercial materials for classroom use; and,

(6) To develop culturally relevant curriculum materials that reflect current ideas in science and mathematics education.

The Science and Mathematics Learning Center at Northern Arizona University, with support from the Bureau of Indian Affairs, offers an in-service program for elementary school educators in science and mathematics education. The SMILE Program selects teams of two to three educators from BIA schools to participate in the program. The teams attend weekend workshops throughout the school year and a three-week summer institute to develop skills and knowledge in science and mathematics so they can return to their schools and become resource specialists for science and mathematics education. In addition to the workshop at NAU, SMILE supports the teams in attending the Arizona Science Teachers Association's Convention. At the completion of the program, the teams are able to provide in-service support for their colleagues and network with the other teams and the Science and Mathematics Learning Center.

All SMILE participants with their eggs that symbolized the Earth they were caring for that day. They had just completed a study of the tree growth at Sunset Crater area.

Applications are sent to all BIA schools in Arizona. The coordinator contacts all the schools that submit applications to make sure that they are still interested in participating in the program, to answer any questions and to speak to the principal. Recruitment begins at this time in an attempt to get schools from all reservations involved in the program. A committee selects the schools that will be invited to participate and the coordinator visits those schools to conduct a needs assessment of the team. The needs assessment is used to plan and organize the five (5) workshops and summer institute.

The five workshops are held on weekends throughout the academic year, based upon the following Program Schedule:

Weekend 1

The workshop begins with an introduction to current ideas in science, mathematics and environmental education. Following the introduc-

tion, the teachers participate in a cultural activity called *Rafá Rafá* and a discussion on the effect of culture on understanding and working with others. For the remainder of the workshop, participants are involved in team building activities, cooperative learning strategies and examine a variety of curriculum approaches and considerations.

Weekend 2

The focus of this workshop is on whole language, science and mathematics instruction. The implementation of thematic units is also discussed. The participants are then introduced to what a module is, how to select a topic for a module and the steps in creating their own module.

Weekend 3

This workshop features the initial steps to developing modules and curriculum. The first several steps in developing a module are discussed in detail and then the teams work together to create their school's scope and sequence for science from data gathered in a school-wide survey.

Mr. Eddie Toledo and Ms. Lorraine Lee from Tonalea Day School make prints of animal tracks on a greeting card during the Whole Language workshop.

Weekend 4

This workshop focuses on the remainder of the steps in developing a module. Making activities culturally relevant and how to arrange activities in their module using the learning cycle is also examined. Speakers are brought in to share their ideas about action projects and what they are doing at their school.

Weekend 5

The final weekend workshop highlights teaching mathematics from a different perspective using hands-on, minds-on activities for all levels.

The educational benefits to students participating in the SMILE Workshop include the following:

(1) Teachers implement new approaches to teaching science, math and environmental education;

(2) Teachers implement a variety of instructional strategies in science and math;

(3) Teachers learn to adapt commercial materials for classroom use;

(4) Teachers select and obtain resources available for science and math; and,

(5) Teachers develop culturally relevant curriculum materials that reflect current ideas in science and mathematics education.

The estimated cost of the SMILE Workshop is $300,000 including participant support costs, teacher stipends, travel, housing, food, materials and supplies.

For further information regarding the "Science and Mathematics for Indian Learners and Educators Workshop," you may write or call:

Dr. Carol R. Adkins
Coordinator
SMILE WORKSHOP
Northern Arizona University
P.O. Box 5697
Flagstaff, Arizona 86011
(602) 523-7521

11.
SANDIA NATIONAL LABORATORIES
Albuquerque, New Mexico
"BIA Hands-On Science and Mathematics Workshop"

Beginning in 1991, high content level classroom-practical science and mathematics professional development instruction has been provided to Bureau of Indian Affairs Educators in hands-on science and mathematics. The instruction included general means and methods as well as specific content, heavy education and training, all delivered as kit-based and project-based science and mathematics courses. The courses were derived from in-class team teaching efforts conducted at BIA schools by Department of Energy National Laboratory technical staff and Bureau of Indian Affairs practicing teachers and administrators. The joint work was performed under the auspices of a Department of Interior and Department of Energy Memorandum of Understanding to enhance Native American Science and Mathematics Education performance.

The hands-on science and mathematics courses were developed initially in the Shiprock area of the United States, in direct response to teacher requests for professional science and mathematics development courses to be provided for credit. The courses were designed and delivered using some special system analysis and optimization methods, provided by the technical team members, which allowed the rapid reviewing, evaluating and identification of any and all "best improvement" measures for the general teaching industry.

The courses began as workshop topics presented by the Department of Energy Laboratories staff to Shiprock Agency educators during a summer study session conducted at the Navajo Community College in Shiprock, New Mexico. The initial course ideas were then refined as a joint effort between the DOE/BIA team and the Montezuma-Cortez School District in Colorado, where the first formal course was presented on the hands-on means and methods developed in Bureau of Indian Affairs classrooms. The course provided graduate

Applied Project Engineering in action.

education credit through Adams State College of Alamosa, Colorado, for teachers of the Four Corners while simultaneously allowing DOE laboratory staff to have a means of collecting education performance and evaluation data on their content specific education contributions for teachers.

The performance and evaluation data were then subjected to joint review and evaluation, for utility and practicality in the "real classroom." The joint review, team teaching and co-development teaming concept practices have since grown in parallel, as a direct spin-off of the hands-on courses, into a full education systems improvement team with an embryonic supporting structure to facilitate its development(s). It is now exploring all methods of science and mathematics education enhancement, by the same means used to develop the courses. Distance Education means, methods, and advanced technology for the classroom are three of the current main focus efforts. They will be approached from the solid content foundation of the courses and practical utility testing in the net co-development environment of the team participants.

The hands-on courses are presently being provided by Sandia National Laboratories staff working with Adams State College under a joint Sandia/Adams Memorandum of Agreement to enhance science and mathematics education, and

the Office of Indian Education Programs of the Bureau of Indian Affairs. By the end of July 1994, specific courses in the Hands-On Science topics of Means and Methods, Sound, Electricity and Magnetism, Energy and Ecology, and Light and Optics will have been given to over 100 Bureau of Indian Affairs teachers and administrators in the Shiprock and Eastern Navajo Agency and at the Haskell Indian Nations University. The first "Master Teachers" of the courses are just becoming available to act as role models, facilitators and co-teachers of the formal courses.

The latest courses provide hands-on instruction in technical Enan, E-Mail, Internet and electronic and telecomputing methods for the practical science and mathematics classroom. The co-development efforts are progressing in parallel and have been testing Distance Education methods for delivering the courses and course products to remote site classrooms. A geostationary satellite delivery of a portion of one of the electricity and magnetism courses has been the most aggressive test of this kind to date. Future tests are planned for computer network and wireless computing tests of better and more cost effective science and mathematics education delivery methods. It is hoped that professional development courses can be made readily available to all educators in the remote BIA school systems and that the course products in turn can be delivered rapidly and efficiently to all learners of all ages of the Native American education system.

The educational benefits to teachers include the following:

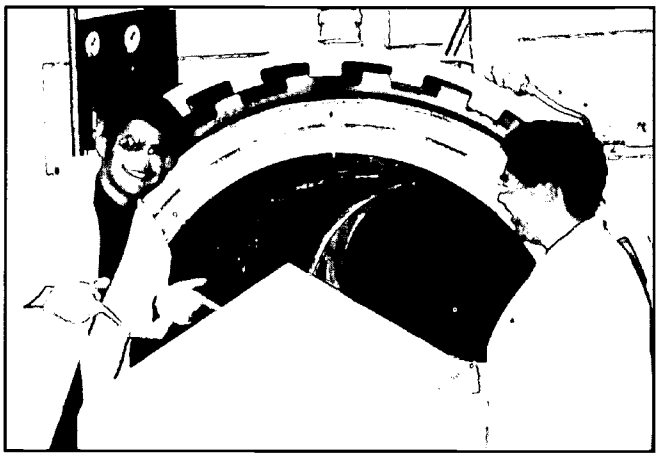
(1) Hands-on science and mathematics education;

(2) Graduate or undergraduate college credit;

(3) Formal professional career development; and,

(4) Joint research and development experience with scientists.

This workshop was subsidized by direct and in-kind support from the Bureau of Indian Affairs, Office of Education Programs, Eisenhower Program funds, the U.S. Department of Energy, and practicing educators of the State of Colorado. The estimated cost to start the workshop was approximately $150,000. This cost includes the provision of the workshops, training, salaries and travel.



See! Science <u>really</u> works.

For further information you may write or call:

Dr. Byron Dean
Program Coordinator
MS-1351, Dept. 3020
Sandia National Laboratories
P.O. Box 5800
Albuquerque, New Mexico 87185
(505) 889-2322

Sandia National Laboratories

12.
SANDIA NATIONAL LABORATORIES
Albuquerque, New Mexico
"RAISE: Rural American Indian Science Education Workshop"

Sandia National Laboratories, located in Albuquerque, New Mexico offers a variety of programs designed to assist teachers of American Indian students in the instruction of math and science education. One such program in known as RAISE, the Rural American Indian Science Education Workshop. This workshop was established in the Summer of 1991 as a cooperative agreement between Sandia National Laboratories and the Bureau of Indian Affairs. The workshop has served the educational needs of one hundred twenty-three (123) participating schools in the states of Arizona, Oklahoma, Oregon, Maine, Montana, New Mexico, North Carolina, North Dakota and South Dakota. Albuquerque Indian Education teachers and aides, and seniors in the University of New Mexico College of Education program also participate in training and activities. Supplemental funding for this program is provided by the Bureau of Indian Affairs. Major activities include: (1) an intensive two week accredited, teacher training during summer; (2) a six week teacher training and research opportunities; (3) a six week college bound summer program for high school students; and, (4) two semester visits from a Science Advisor, or "SCIAD."

Sandia National Laboratories' Education Outreach Department began the Science Advisors Program in 1990. It utilizes the expertise at Sandia by assigning employees to work one day a week at school in order to help teachers become more knowledgeable and comfortable in teaching science. Collaboration of teachers and Sandians has helped to bring a hands-on approach to science in the classroom.

In 1991, RAISE expanded the original concept of SCIADs to include a long distance relationship with rural schools. RAISE SCIADs use

An American Indian Science team.

long distance technology and communications in lieu of weekly on-site visits. Various methods of communication include: telephones, faxes, video imaging phones, and computer access via modem to an electronic bulletin board. In addition, the SCIAD visits the school once each semester to provide in-service teacher workshops and classroom discussions and demonstrations.

There are two major components of the summer workshops: an Elementary Component and a Secondary Component.

The elementary component of RAISE is piloting a new type of science and math curriculum for school implementation. Therefore, this component will be held independent of the other workshop. This year's training workshop will be focused on learning the activities associated with the kits/modules to be used in the school. The name of the curriculum is the Full Option Science System (FOSS). The format includes six modules and kits to be presented during the week. The RAISE secondary component is a two week teacher workshop. The first week of the workshop is for training in the specific use of the activities and kits. The second week is scheduled for student teaching and computer

training. There will be separate class schedules and kits for both math and science teachers. Remote sensing and computer educational technology are scheduled for all teachers.

The secondary component consists of a two-week, college accredited training workshop. Secondary teachers in the areas of science and math are encouraged to attend. The grade range of activities presented is from grades 7-12. The teacher training workshop will be held in conjunction with the SIPI College Bound Program. The College Bound Program lasts for six weeks from June 13th through July 18th. This program is a summer science and math camp for American Indian students in grades 9-12. Each school sending a teacher is encouraged to also send a student, although this is not a requirement. Students apply through the Southwestern Indian Polytechnic Institute. The workshop is held on the campus of the Southwestern Indian Polytechnic Institute, located approximately five miles north of Albuquerque, New Mexico.

Two primary goals of the workshop include the following:

(1) To develop a science education program for rural American Indian populations which will enhance the image of science in the community, provide access to persons with technical careers, and enhance scientific and critical thinking skills of students; and,

(2) To augment the science teaching skills of teachers in rural area schools by providing intensive, accredited summer training and workshops; equipment and science kits to individual schools; access to technical assistance; hands-on training materials in science and math concepts; and culturally relevant materials in the area of science and technology.

The educational benefits to teachers and students attending the RAISE Workshop(s) include the following:

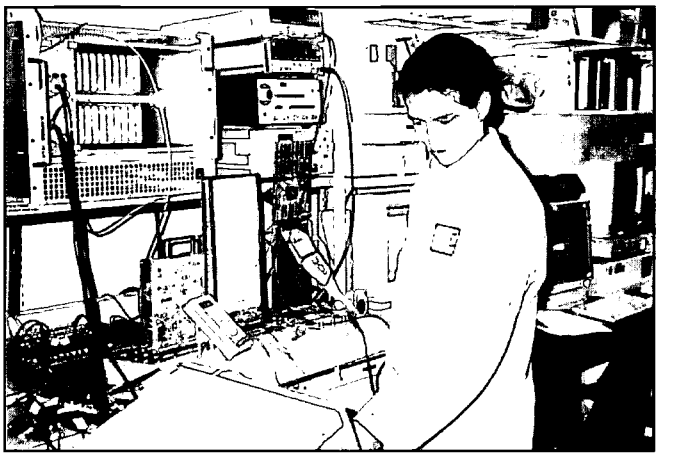
(1) Accredited course work;

(2) Augment science teaching skills;

(3) Hands-on training materials use; and,

(4) Culturally relevant materials use.

This workshop was subsidized by direct and in-kind support from the Bureau of Indian Affairs, Office of Education Programs, Eisenhower Program funds, and the U.S. Department of Energy. The estimated cost to start the RAISE Workshop was approximately $150,000. This cost includes the provision of the workshops, training, salaries and travel.



Science and electronics in action.

For further information you may write or call:

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P.O. Box 5800
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13.
SAN SIMON ELEMENTARY SCHOOL
Sells, Arizona
"San Simon Elementary School Math Technology Program"

Top and Bottom: San Simon Elementary School students using computers.

The San Simon Elementary School is located in Sells, Arizona on the Tohonno O'odham Indian Reservation approximately seventy (70) miles from Casa Grande, Arizona. The school was established by the Bureau of Indian Affairs in 1978 and currently serves 290 O'odham students in grades K-8 under the direction of Ms. Della Williams, Principal.

The purpose of the "San Simon Elementary School Math Technology Program" is to improve the computer and technology related skills of its students.

The six primary goals of the program include the following:

(1) To use computers and telecommunications to assist teaching;

(2) To develop the students' computer literacy skills;

(3) To develop a higher interest in learning mathematics;

(4) To communicate with other tribal students;

(5) To develop better communications with parents; and,

(6) To study new telecommunications advances.

Investment in our Native American students' potential is the motivation behind our math/technology emphasis. In 1986, a lab was started with one Apple IIe computer. The staff was enthusiastic, the students liked learning with computers, and careful preparation and ordering of computer software was accomplished by Mr. Paul Wiest and the administration. When the students ran to the Math Lab, their enthusiasm persuaded the administration to approve more computers. The Math Lab grew to 12-15 computers and the students' achievement increased +6NCE's in math every year with an installed computer network of ideal learning management at Milliken networkable software for grades 5-8.

SAN SIMON ELEMENTARY SCHOOL

Up to five computers were placed in every classroom now that students were more computer literate. This year a new "LocalTalk" computer network using Appleshare management of Milliken networkable software was installed in Grades K-4. At present, the "bugs" in the network are being eliminated before Fall when school begins and a new group of students enter kindergarten.

Sandia National Laboratories trained Mr. Paul Wiest and Ms. Verna Morrow, the teacher Supervisor, on using math and science with a camera-operated videophone. They donated the computer to our school so that the students would be able to send math and science project pictures to other Native American students in Bureau of Indian Affairs schools nationwide.

Several types of student projects were initiated. Examples include: computer literacy, measuring the solar system, growing flowers, measuring volume of liquids, using money effectively, multi-cultural math games, and learning basic facts, basic skills and higher-order thinking skills. A "Game Day" was hosted on Fridays to reward students for successfully passing their tests. Macintosh games were loaded on the hard drive that the math teacher won in a grant contest at the SMILE Workshop hosted last summer by the Northern Arizona University, located in Flagstaff, Arizona.

Students in the "San Simon Computer Club" are being trained to operate both Macintosh and IBM computers. The computer club meets each Friday at 2:00 p.m. for an hour. Volunteer students who have behaved well in the classroom and on the playground are also in attendance. Fifteen to twenty-five students will soon earn their certificates for computer literacy.

In addition, the Gifted and Talented Program uses a laserdisk machine and movie clips to generate stories on the computer via programs such as "Hyperstudio," "Hypercard," or CD-ROMs. Also, the Special Education Program utilizes computers for a variety of programs.

The students are using disks, CD-ROMs, and the videophone to train on the new "Internet" world-wide information highway. In one example of improved communications Cherokee High School, located in Cherokee, North Carolina, was contacted on the videophone.

Both the teacher supervisor and school counselor use computers and the paraprofessional staff members attended a Computer Education course offered by Prescott College. The next challenge is to link the Macintosh and IBM computer to the "Ethernet" network. One student is working with the math teacher to obtain grants from businesses and foundations to install the "Internet/Ethernet System."

The educational benefits to students participating in the "San Simon Elementary School Math Technology Program" are as follows:

(1) Increased math NCE scores;

(2) The improvement of individualized study skills;

(3) The awareness of new media for learning; and,

(4) The utilization of an interdepartmental, multicultural tool for communications.

The estimated cost required to start the "San Simon Elementary School Math Technology Program" was approximately $78,000. This cost includes the purchase of computers, software, computer networks, maintenance and training. However, training for the use of the videophone was provided at no charge by Sandia National Laboratories.

For further information you may write or call:
Mr. Paul Wiest
Math Teacher
San Simon Elementary School
HCR 225
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14.
SINTE GLESKA UNIVERSITY
Mission, South Dakota
"Science Education Training Project Workshop(s)"

Sinte Gleska University, located on the Rosebud Indian Reservation in South Dakota, in cooperation with the South Dakota School of Mines and Technology, located in Rapid City, South Dakota, has hosted the "Science Education Training Project" since 1991. During the summer of 1994 two 2-week workshops were held in Rapid City, South Dakota on the campus of the South Dakota School of Mines and Technology for 120 elementary teachers of Indian children in the Bureau of Indian Affairs schools and tribal schools. Both workshops are offered exclusively for teachers of American Indian students in grades K-8.

Sinte Gleska University has conducted this workshop for five years and has refined a team approach model to change instructional behavior in a positive manner, particularly in regard to hands-on and cultural integration strategies. The workshop was initially established through consultation with science and mathematics educators and reservation-based model elementary teachers. In the Fall of 1992, the project was honored by the U.S. Department of Education as a "Model Project," and as a "Showcase" presenter at the 1993 annual convention of the National Science Teachers Association.

Doing work in lab.

Developing and presenting science/math lessons.

The South Dakota School of Mines is a nationally recognized school that focuses on training and research in science, mathematics, and engineering. They have excellent facilities for various science and technology fields. Located in Rapid City, South Dakota at the edge of the Black Hills, which holds a special significance to all of the tribes in the area, this location provides an excellent backdrop for training teachers of Indian children. In addition, the School has agreed to collaborate in the teacher training project as part of their efforts to work more closely with tribes and tribal colleges, particularly those in South Dakota. This first collaboration between an American Indian University and the School of Mines is historically significant, and serves as a model of cooperation between American Indian and non-Indian institutions of higher learning nationwide.

The project is under the management of one Project Director with the assistance of four (4) instructors. During the first week of each workshop, participants are provided hands-on math and science activities utilizing expert consultants in these fields. In 1990-92, the University utilized Dr. Gerry Haukoos, a science educator from Illinois State University. In 1993, Mr. Mark Ward of Sinte Gleska University served as the science educator. During the summers of 1992-1993, the project was joined by Dr. Jerilyn Grignon,

Menominee, a mathematics educator from Oklahoma State University. Two Native American model teachers assist the consultants in a number of ways: (1) to conduct break-out sessions when small group activities are necessary; (2) to enhance activities through the interjection of Whole Language techniques; (3) to provide techniques and activities for curriculum integration; and, (4) to demonstrate ways in which American Indian culture can be integrated into science and mathematics education. This team approach model has been used for five summers and has been well received, especially the integration of culture into science and mathematics education.

During the second week of the workshop, the project provides participants with curriculum development skills. Native American model teachers facilitate the development of math and science topics that will fit very well in the participant's teaching environments. The development activities are completed in groups so participants may experience the cooperative learning environment. The topics are selected by the participants and are woven into the Whole Language approach, utilizing well defined objectives, materials, activities, procedures, enrichments, and methods for evaluation. The model teachers facilitate the use of culture to provide relevance to science/math topics by ensuring the integration of science and mathematics into the elementary curriculum. This strategy is very effective in the development of culturally relevant hands-on materials for participants' use in their local schools.

In addition instructors from the South Dakota School of Mines and Technology are utilized for the provision of complimentary content and strategies. This includes, computers, space studies, and the use of museums in science and math instruction.

During one weekend of each workshop, a field trip is taken to culturally and scientifically relevant sites, including, the Crazy Horse Memorial, the sacred Black Hills and the mammoth sites located in the Badlands of South Dakota.

Each participant has the opportunity to receive four (4) semester hours of graduate credit for the 2-week workshop.

The primary goal of "Science Education Training Project Workshop(s)" is to provide elementary teachers of Indian students with content, methods, activities, evaluative strategies, and curriculum development skills necessary for the implementation of culturally based hands-on science and math activities in their classrooms. This is an empowerment process that includes the development of confidence, as well as knowledge and skills.

Four project objectives are identified as follows:

(1) To provide 120 participants with 30 hours of science/math content and concepts through hands-on activities;

(2) To provide 120 participants with 30 hours of training in the development of culturally based hands-on science/math topics;

(3) To provide 120 participants with practical, usable lesson plans; and,

(4) To provide 120 participants the opportunity to earn four semester hours of graduate credit.

Five educational benefits to science and mathematics teachers attending the workshop(s) include:

(1) The development of model hands-on science and mathematics skills;

(2) The development of cultural integration methods for utilization in the teaching of science and mathematics;

(3) The acquisition by participants of appropriate pedagogy;

(4) The acquisition of new curriculum development skills; and,

(5) The acquisition of four hours of graduate credit.

The cost of the two workshop(s) is $200,000 per summer.

For further information regarding the "Science Education Training Project Workshop(s)" you may write or call:

Dr. Leland Bordeaux
Director
Sinte Gleska University
P.O. Box 8
Mission, South Dakota 57555
(605) 856-2886 - Fax:(605) 856-2011

15.
SOUTHWESTERN INDIAN POLYTECHNIC INSTITUTE
Albuquerque, New Mexico
"SIPI College Bound Math and Science Enrichment Program"

Cray Supercomputer Facilities in Lawrence Livermore National Lab: Jim Lewis, Karen Scott, Dennis Vargo, Evans Craig, Alfreda Charlie, Emerson Charlie, Serf Lunquist, Anita Begay, Juanita Bunney, Katrina Curtis, Carmel Dewakuku, Isaaca Gonzales, Jerel Johongeua, Brandy Malone, Cheryl Dino, Jamie Rico, Tim Sarver, Gary Segay, John Vargo, Colleen Woodman, Henrietta Yabeny, Rolanda Yazzie, Sarayl Yellowhorse, Rodney Johnson, Raelene Zospan, Priscilla Cummins, Paul Atovcio

The Southwestern Indian Polytechnic Institute, better known as SIPI, is located three miles directly north of Albuquerque, New Mexico. SIPI is a post-secondary technical/vocational school serving American Indians from across the nation. The Institute has sponsored a summer academic enrichment program since 1989, and in 1990 was designated as a regional math and science center. This program began as an Upward Bound program funded by the U.S. Department of Education in 1990; however, funding is now provided by the Bureau of Indian Affairs and the U.S. Department of Energy. The U.S. Department of Energy will provide funding to expand the College Bound program for the next three years.

Two administrators currently manage the program, with the assistance of twelve teachers, plus engineers and scientists from Sandia National Laboratories, and eight teachers from the Rural American Indian Science Education (i.e., RAISE) Program. A total of sixteen teacher aides are employed by the program, which serves American Indian students from tribes throughout the nation.

These summer residential programs provide academic enrichment, exposure to career opportunities and role models, and a college dormitory living experience. Communications skills, study skills, goal setting, personal development, self esteem, fitness, social skills, teamwork and computer literacy are also stressed.

The six goals of the "SIPI College Bound Math and Science Enrichment Program" are identified as follows:

(1) To develop a model for project based math and science enrichment;

(2) To explore and evaluate the most effective use of institutional partnerships;

(3) To integrate student and teacher enrichment;

(4) To improve math and science education in rural schools;

(5) To increase the number of Indian students going on to college; and,

(6) To increase the number of Indian students going on to science and math careers.

During the school year the students work on assigned projects with coordinators at their high schools. These projects are used to keep the students working toward their education goals and to strengthen the students' computer networking skills. Since 1991, a one week workshop at the NERSC Super computer facilities in Livermore, California has been included in the program. This workshop introduces students to the Cray Supercomputer and the networking skills involved in using this computer. The workshops are conducted by staff from both the Sandia and Lawrence Livermore National Laboratories.

In 1993, the Summer College Bound Math and Science Enrichment Program successfully integrated new computer application projects with hands-on instruction and expanded the institutional partnerships between SIPI and the National Laboratories. This past year, 82 high school students from many states were served, including Maine, South Dakota, North Carolina, Alaska and the Southwest. Sixty-seven percent (67%) of the students were female. There was aggressive recruitment of young women with the goal of increasing the numbers of minority women in math and science fields. The student population was represented by fifteen (15) tribal groups. Eighty-nine percent (89%) of the students were identified as either low income or first generation college students (e.g. neither parent had attended college). The grade equivalent gains exceeded the normal gains that would be expected in a six week program, as experienced in past years.

The Supercomputer Workshop using the Cray computer at the Lawrence Livermore National

Laboratory again was a very successful component of the Summer Camp. This year twenty (20) students attended this week-long workshop. More than forty (40) students submitted applications via electronic mail, based upon their desire to develop a project and attend the workshop. The finalists were chosen by SIPI's computer science instructor, Mr. Evans Craig, who conducted the training, and Mr. Dennis Vargo, the Program Coordinator. The emphasis this year was on Environmental Science, and as a result, this year's project focus on environmental simulation software on the supercomputers. However, other equally attractive computer application components were added to the program for those students who did not go to Lawrence Livermore National Laboratory. The components were Microstation, a computer-aided design package that was converted to a virtual reality format; Internet, a national electronic mail network; Fractals, a self-replication math equation which draws designs emulating nature's geometry; and Climoman, an environmental simulation program. All components were project based with an emphasis in Environmental Science. The components utilized supercomputer processing, telecommunications and the research resources available through Internet. Each component culminated with field trips to organizations involved in work related to the project-based component. Microstation was completed in conjunction with Sandia National Laboratories and culminated in the CAD model, developed by the students, being placed in Sandia National Laboratories' Virtual Reality Research Facility. The students went to Sandia National Laboratories and were able to experience their model in a virtual reality environment. Students working with fractals took a trip to Los Alamos National Laboratory, which is on the forefront of research in this area. Those working on the Internet component took a field trip to New Mexico Technet, and spent time utilizing their learned skills with the Internet.

A visit to the New Mexico State Museum of Indian Arts and Culture: Chris Chico, Tim Sarver, Justin Adaki, Alexandra Frances.

All of the components were project based. The students utilized state-of-the-art technology to develop their hands-on projects and to experience industries' application of these technologies first-hand. Then the students used telecommunications and computer/supercomputer technologies extensively to develop their projects. In addition, the students were involved in remote sensing technology. Environmental science student projects were built around the acquisition and analysis of satellite images of the earth. Students assembled and mounted the satellite dish, and then used computer hardware and software to download images from orbiting satellites. This gave them a whole new perspective on our world. They could see a storm form and move into the area before it was experienced and they began to see the patterns and interrelations of weather from a global perspective. For example, they began to understand how pollution in one county could affect other countries not responsible for the pollution, so that pollution must be of worldwide concern. The math and science behind this and other technologies, such as orbital mechanics and the electromagnetic spectrum, were explored in the math and science classrooms. An important goal for the program was to relate the math and science taught in the classroom to the application of current and future technologies.

For the second consecutive year two students from the program were selected to attend the National Science Foundation Conference in Washington, D.C., entitled, "Diversity In the Scientific and Technological Workforce."

The education benefits to students attending the program include the following:

(1) Training in the latest technologies;

(2) Immersion in project-based instruction;

(3) A residential college dormitory experience;

(4) The opportunity for mentoring by National Laboratory scientists; and,

(5) Exposure to science and mathematics careers.

The cost of the program is approximately $350,000 for staff salaries, student expenses, equipment, travel and other related expenses.

For further information regarding the "SIPI College Bound Math and Science Enrichment Program," please write or call:

Mr. Joe Skenandore
College Bound Coordinator
Southwestern Indian Polytechnic Institute
SIPI College Bound Math and Science
Enrichment Program
P.O. Box 10146
Albuquerque, N.M. 87184
(505) 897-5347

16.
TAOS DAY SCHOOL
Taos, New Mexico
"Community Academies for Science and Mathematics"

The Taos Pueblo Day School is located within the Taos Pueblo, two miles north of Taos, New Mexico. The Rio Pueblo River, the outflow of "Blue Lake," the sacred lake of the Taos People, flows through Taos Pueblo. Blue Lake and the surrounding wilderness were the subject of a sixty-four year struggle by the Taos People to regain their rights to their sacred lake and lands.

Taos Pueblo Day School was established in 1926 by the Bureau of Indian Affairs, and a new school was constructed in 1936. A BIA-operated school, it is staffed by one principal, eight certified teachers and eight teacher-aides. Taos Pueblo Day School serves the educational needs of one hundred fifty-two (152) Taos Pueblo students in grades K-6.

The "Community Academies for Science and Mathematics," CASM, program began in 1993 and directly involves seven of the eight certified teachers. The primary goal of the program is to provide all 152 students and their parents with as many positive, hands-on experiences with science and mathematics.

The activities are designed to expose the students to a wide variety of science and math areas and the careers related to those areas. Role models from the Pueblo speak to the students and share their talents and skills during the activities. A multi-cultural, or Native American, perspective is included when possible.

The Taos Pueblo Day School attempts to ensure that all programs at the school, including the "Community Academies for Science and Mathematics" program benefit each of the students in attendance. Therefore, the school has made every effort to make the CASM program school-wide, with all staff members involved in the training, planning and implementation of all activities. The local Parent Teacher Organization, (PTO), consisting of teachers, parents, community members, tribal officials and school board members, is utilized as the advisory group for all projects at the school. It meets monthly to address the needs of the school and to organize activities. The judges for the Science Festival are provided by the following institutions: (1) the Los Alamos Labs; (2) the War Chief's Staff; (3) the Taos Pueblo Governor's Staff; (4) the Northern New Mexico Community College; (5) the CASM; and, (6) the National Indian Youth Leadership Program.

Ms. Randy Thorne, CASM Coordinator; Mr. Robert C. Martinez, Principal

Fourth graders construct an edible landfill.

The five major educational benefits to Taos Pueblo students participating in this program include the following:

(1) Early access to activities that nurture students' interests, while developing their abilities in science and mathematics;

(2) Encouragement to explore and experience scientific phenomena in a nonacademic setting;

(3) Providing parents with ready-to-use activities so that they can promote scientific curiosity and understanding in their children;

(4) Role models for the Pueblo who speak to the children and share their talents and skills with them; and,

(5) A multi-cultural, or Native American, perspective of science and mathematics.

The cost to start the "Community Academies for Science and Mathematics" program was approximately $4,000.00. These funds were used to purchase a wide variety of science equipment, computer software, and for field trips. Funding for the program was provided from a variety of sources.

For further information regarding the "Community Academies for Science and Mathematics" program, please write or call:

Ms. Randy M. Thorne
Science Teacher
Taos Pueblo Day School
Drawer X
Taos, NM 87571
(505) 758-3652

17.

THEODORE JAMERSON ELEMENTARY SCHOOL

Bismarck, North Dakota

"Native Americans in Science Program"

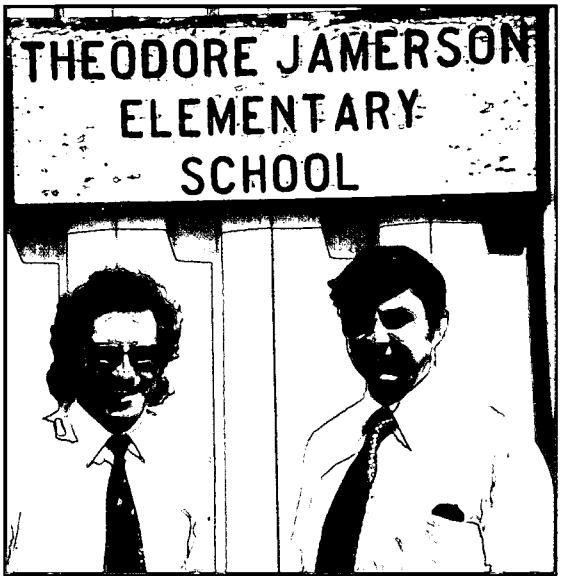
Theodore Jamerson Elementary School is located on the campus of United Tribes Technical College (UTTC), three miles south of Bismarck, North Dakota. The school was established in 1973 as a P.L. 93-638 school to provide elementary education in grades K-8 to students that attend United Tribes Technical College. While the primary tribe served by the school is the Standing Rock Sioux Tribe, in 1994 the school served students from twenty-one (21) tribes throughout the nation.

The "Native Americans in Science Program" evolved from one persistent, dedicated teacher, Mr. Dorvin Froseth, who insisted upon science being taught in every grade level.

The four primary goals of the program include the following:

(1) To assist Native American students in becoming aware of the numerous types of jobs available to them in math and science;

(2) To elevate student awareness of their environment;



Mr. Sam Azure, Principal
Mr. Dorvin Froseth, Science Teacher

(3) To elevate student awareness of their natural resources and conservation; and,

(4) To motivate students in the areas of science and mathematics.

After attending a science workshop coordinated by the American Indian Science and Engineering Society (AISES), a science teacher, Mr. Dorvin Froseth, was made aware that there were very few Native Americans in the science and engineering fields. [The American Indian Science and Engineering Society (AISES), is the leading national American Indian science organization in the United States. AISES was established via the visionary leadership of the late Mr. Andrew "Andy" Anderson, an Iroquois and former top executive with Union Carbide Company of New York City, New York.] When he went back to his classroom at Theodore Jamerson Elementary School, located on the United Tribes Technical College campus at Bismarck, North Dakota, the science teacher decided it was time to get the students involved in science by holding science fairs. He felt that this would give them an opportunity to explore areas of science and engineering unfamiliar to them. He could see the motivation and excitement of the students while they were working on their science fair projects. When the first school science fair was over, the students excitedly told him what they wanted to do for the next science fair. From this time forward, the science fair was an annual event at Theodore Jamerson Elementary School.

Students in kindergarten, first, and second grades are included in the science fair through class projects. Some of the second grade students who wish to do individual projects are permitted to do so. Beginning in the third grade, students have the option of doing individual projects or working on teams of three per project. There are seven categories in which science exhibits are accepted: (1) Life Sciences (i.e., Behavioral/Social, Plant/Animal Life, and Botany); (2) Physical Sciences (i.e., Biochemistry, Chemistry and Physics); (3) Earth and Space Sciences; (4) Engineering/Computer Science/Mathematics; (5) Environmental Sciences; (6) Medicine and Health; and, (7) Team Projects. Each category is judged and given a first, second or third place award. Grade levels are judged as K, 1 & 2 group, or individually, according to category with 3-4 grades, 5-6 grade, and 7-8 grades together.

In order to keep the students motivated in science fairs, the science teacher decided to expand the science fair statewide. Since he found most Native American students tend to be quite shy, he thought they would be less threatened if the fair was only open to schools with a majority of Native American students. He invited some teachers from North Dakota reservation schools to a meeting and expressed the idea of creating a "Native American State Science Fair." Their response was one of enthusiasm and excitement. Together, these teachers made plans to hold a "Native American State Science and Engineering Fair," including grades three through twelve, using the same categories used for the first school fair. The first "Native American State Science and Engineering Fair" included seven schools and approximately sixty (60) students. The second year, the fair included fourteen schools and involved one hundred twenty (120) projects. This past year, 1994, twenty-seven schools and four hundred eighty (480) students participated. Students, parents, teachers, and even the community, become involved with the science fair. People in the community are asked to help students with their projects if they are in a profession that deals with a topic the student is studying. Bus drivers, chaperones and others take part by encouraging and praising the students. Whenever students see success in themselves and what they are involved in, they become motivated. Motivation in turn leads to success.

Based upon the excitement generated by students attending the Native American State Science and Engineering Fair, Mr. Froseth decided to keep the students motivated by beginning a "National American Indian Science and Engineering Fair" (NAISEF). He was responsible for initiating the National American Indian Science and Engineering Fair three years after starting the Native American State Science and Engineering Fair. Grades five through twelve are included at the national fair and the categories for the national fair are the same as the Native American State Fair. The first three years NAISEF was held in Bismarck, North Dakota, because the committee for the State Science and Engineering Fair was already in place. The fourth year, a committee was formed for NAISEF and the science fair was held at Las Cruces, New Mexico. The fifth year it was held in Milwaukee, Wisconsin, and the sixth year, in 1993, it returned to Bismarck. Participation has increased to over 900 entries. The NAISEF is judged by professionals from various math, science and engineering occupations. They have repeatedly indicated that the quality of the projects is excellent. Six participating students are selected each year to attend the International Science and Engineering Fair. It is highly evident that science fairs have motivated increasing numbers of Native American students toward entering math, science, or engineering as a profession.

Kathy Larabee, waiting for the judges

The educational benefits to students participating in the science fairs include the following:

(1) Students develop a positive self image and feel that they can successfully compete with other students;

(2) Science students become better students overall and serve as role models for younger students;

(3) Students gain confidence to tackle problems and become better problem solvers; and,

(4) Students become aware of the opportunities available to them through math and science education.

The cost to start the first science fair at Theodore Jamerson Elementary School was minimal. Funds were provided by the regular budget, but many supplies were donated by local and national companies interested in the project.

For further information regarding the "Native American in Science Program" you may write or call:

Mr. Sam Azure
Principal, United Tribes Technical College
Theodore Jamerson Elementary School
3315 University Drive
Bismarck, North Dakota 58554
(701) 255-3285

18.
TURTLE MOUNTAIN COMMUNITY HIGH SCHOOL
Belcourt, North Dakota
"Science Enrichment Program"

Turtle Mountain students at the Regional Science Fair after they won the high point award for having the most qualifiers of all schools in North Dakota.

Bird's-eye view of the National Native American Science Fair in Albuquerque, New Mexico.

The Turtle Mountain Community High School is located in Belcourt, North Dakota on the Turtle Mountain Indian Reservation. The school, established in 1940 by the Bureau of Indian Affairs, has evolved into a BIA Grant school administered by one superintendent, one principal, thirty-six certified teachers and sixteen teacher-aides, serving the educational needs of approximately five hundred fifty (550) Turtle Mountain Chippewa students in grades 9-12.

The "Science Enrichment Program" was established in 1987 with the provision of school activity funds. Three teachers direct the program which serves thirty (30) students;

The three goals of the program include the following:

(1) To introduce students to proper research techniques and scientific methods in order to collect data, perform experiments, and draw conclusions;

(2) To involve students in the design and construction of a science fair project; and,

(3) To introduce students to science enrichment programs throughout the United States.

The program began seven years ago at the science fair competition, when it was learned that the students were competing at the elementary and middle school levels but not at the high school level. Although there were several science fairs, including the state competition and the regional competition, there was no one working to prepare the high school students for these competitions. For this reason a Science Olympiad was established. The Science Olympiad includes several minicompetitions that test skills in many different areas of science. It shows high school students that science and competition can be fun. Next, a series of summer programs were introduced to give students an opportunity to explore all areas of science before entering college.

A Regional Science Bowl competition was added last year to give the students a chance to excel in more areas of science.

In 1989 the State Native American Fair was managed by the American Indian Science and Engineering Society (AISES). It became a

national science fair with winners going on to compete in the biggest science fair of all, the International Science Fair. For the last five years the school has competed in three science fairs annually. During the past three years of competition, each Turtle Mountain High School student who brought a project to the "North Dakota State Native American Science Fair" has placed first, second or third in their category. In 1993 ten special awards were presented to the students, winning ten out of twelve categories at the fair. In 1994 Turtle Mountain Community High School had twenty-three (23) projects displayed, each of which placed in their categories. Twelve of the thirteen first places went to Turtle Mountain, and special awards included, Best Project in the 9th, 10th and 12th Grades; Best Project by Females in the 9th and 10th Grades; Best Engineering Project in the 11th and 12th Grades; and, Best Earth Science Project, which earned a cash award of fifty dollars.

The National Native American Science Fair rotates to different states annually giving students the opportunity to compete in Wisconsin and New Mexico. In 1993 Turtle Mountain won ten awards at this fair, four categories, and several special awards. One student qualified for the International Science Fair. In 1994 twenty-five students attended the Native American Science Fair held in Albuquerque, New Mexico. Eighteen students received awards, and four won their entire categories. Special awards included the following: the Junior Engineering Award; the Navy Award; the Yale Science Award; the Surgeon General Award; the Forestry Award; and, a $500 cash award for Best Earth Science Project. Two students were chosen to compete in the International Science Fair and three were chosen as alternates.

Outstanding students have been accepted to attend "Summer Science Enrichment Programs" at the following universities: Stanford University, the University of Iowa, Ball State University, the University of Wisconsin, Brandeis University, the University of Vermont, the University of Colorado, the University of North Dakota, and, the University of Portland.

The enrollment in our "Science Enrichment Program" has increased every year. Many students have received college scholarships directly related to their involvement in the "Science Enrichment Program."

The five major educational benefits to the Turtle Mountain Chippewa students are as follows:

(1) Introduces students to the major areas of science, other cultures, and opportunities;

(2) Provides students a chance to obtain scholarships from science fair competition;

(3) Teaches proper scientific research methods;

(4) Teaches independent thinking and research techniques; and,

(5) Gives students a chance to live in a college setting before actually enrolling in the institution.

The cost to operate the "Science Enrichment Program" is approximately $7,000 per year. These funds are utilized for transportation to the science fairs and Science Olympiad, and for support of the Summer Program.

For further information regarding the "Science Enrichment Program," please write or call:

Ms. Renee Aalund
Gifted and Talented Science Instructor
Turtle Mountain Community High School
P.O. Box 440
Belcourt, North Dakota 58316
(701) 477-6471

19.
TUBA CITY BOARDING SCHOOL
Tuba City, Arizona
"Computers for Life Program"

Ms. Wyman assisting with math.

Tuba City Boarding School is located in Tuba City, Arizona on the Navajo Indian Reservation. The school was established by the Bureau of Indian Affairs in 1902, and remains a BIA-operated school which serves eight hundred ninety (890) students in grades K-8 under the direction of Mr. Jerry Diebel, Principal. While most of the students are members of the Navajo Nation, students from the Hopi, Apache, Paiute and Sioux Nations are in attendance.

The "Computers for Life Program" began in 1990, when the boarding school made a move toward computer assisted instruction. The purpose of the program is to improve student computer literacy.

The four goals of the program include the following:

(1) To ensure computer literacy for all students;

(2) To change the role of computers from games to productive machines;

(3) To assist in basic computer skill performance; and,

(4) To increase student capabilities in mathematics and science.

The Tuba City Boarding School Math, Science and Computer Program is leading the way for its students to live in the 21st Century. The main focus of the program has been in the area of computers. The boarding school operates sixty-five (65) IBM computers on a network. The network system utilized is a baseband system that uses Novell 3.11 operating software. In addition, a CD-ROM machine is also linked to the network and one computer class teaches multi-media presentations.

The computer lab is accessible to all students enrolled, from kindergarten through the eighth grade. The lab is also open four nights a week for public use. The overall focus of the program is the improvement of student abilities in reading, math and language. Most importantly, students may progress at their own rate of learning.

The computer lab provides grade specific programs tailored to meet student needs. Kindergarten students attend six classes which focus on the attainment of reading skills using the IBM program "Write to Read." Five first grade classes do a continuation of "Write to Read," and students have drill and practice in basic addition and subtraction. In second grade, there is a shift from reading to a more involved writing program entitled, "Writing to Write." In this program, students create stories from start to finish. Students enrolled in the third grade, and all subsequent grades, are scheduled twice a week into the computer lab. One day is reserved for math, and another for reading and language skills. The fourth grade focuses on perfecting basic math skills, as well as problem solving strategies. While the fifth grade continues to explore math concepts using the math manipulative software, they also begin to type and present research papers. Some students are introduced to multi-media productions under teacher supervision. Here they learn how to take images from scanners and camcorders and input them onto the computer for later presentation to large groups of people. The sixth grade is progressing toward research oriented tools using the CD-ROM drive. In science tutorials, students begin to understand land forms, volcanos, plants and other subjects. The seventh grade has been using the computer lab to learn how to create a newspaper, and a school newspaper is planned. However, they also learn a variety of pre-algebra skills, and are involved in research. The eighth grade computer lab class attempts to combine all of the basic skills, research skills, and complex presentation skills together in a complete package.

Mr. Tauchin helping with research.

Since the boarding school does not employ a large computer staff, our regular teachers learn their grade-appropriate programs, and manage the lab as if it were their own classroom. All of the programs are accessible to all of the teachers.

Four educational benefits to students participating in the "Computers for Life Program" include:

(1) Increased computer skills;

(2) Increased questioning and exploration skills;

(3) Heightened motivation to explore complex problems; and,

(4) Heightened student self-esteem.

The estimated cost to start the "Computer for Life Program" at Tuba City Boarding School was $150,000. This cost includes the purchase of sixty-five (65) personal computers and related software.

For further information regarding the "Computers for Life Program" you may write or call:

Mr. Richard Zilm
Math, Science and Technology Program Director
Tuba City Boarding School
P.O. Box 187
Tuba City, Arizona 86045
(602) 283-4531 Ext. 337

20.
UNIVERSITY OF ARIZONA
Tucson, Arizona
"University of Arizona Holistic Science and Whole Language Works"

The Department of Language, Reading and Culture of the College of Education, the University of Arizona, is located in Tucson, Arizona. Since 1990, the "University of Arizona Holistic Science and Whole Language Workshop," which was established within the College of Education, has been held in this location.

The purpose of the "University of Arizona Holistic Science and Whole Language Workshop" is to provide a high quality Whole Language Math and Science workshop to teachers of American Indian children throughout the United States. In fact, it was part of the Whole Language Bureau of Indian Affairs Workshop. Ten instructors are directly involved in the program which serves eighty (80) students per year.

The three primary goals of the workshop are:

(1) To develop philosophical foundations for the integration of language arts and science and math;

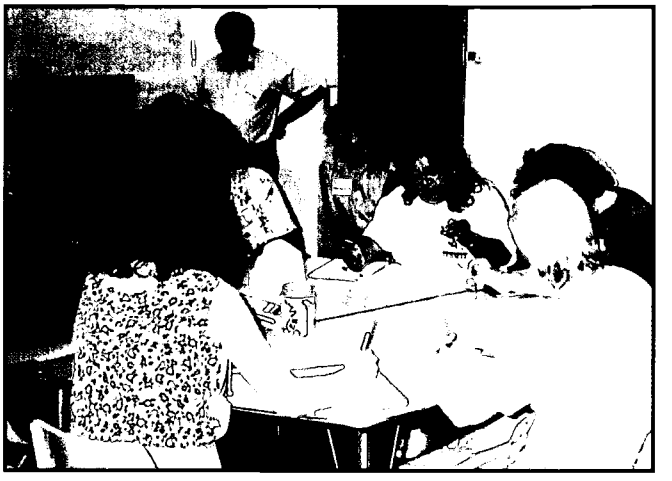
(2) To build the relationships between the use of oral and written language as a tool for the development of science and math concepts; and,

(3) To add to an established set of teaching and learning strategies.

The Program Directors, Drs. Ken and Yetta Goodman, are former classroom teachers who have become two of the driving forces worldwide in rethinking schooling and education. They are most often associated with literacy education, but their work involves the holistic nature of learning and the valuing of all sign system literacies which people use. Their continuing work with the science and math workshops reinforces the connectedness of all things, and emphasizes their concern for learning in school settings and for all people in those settings.

Ken and Yetta have been involved in research and educational projects with the Navajo, Hopi, Zuni, Pima, Tohono O'odam and Yaqui among others, as well as with all tribes represented in the Bureau of Indian Affairs workshops.

Ken is best known as a practical theorist, researcher and teacher educator whose work has changed our understanding of literacy. His psycholinguistic theory of the reading process is the most widely cited in the world. This research based theory demonstrates that reading is a unitary process in which readers actively construct meaning — they make sense of print. Ken's theory is a macro view which is solidly



World renowned Educator Dr. Kenneth S. Goodman observing students attending the "University of Arizona Holistic Science and Whole Language Workshop."

Workshop students observing some young dancers.

built on linguistic, psycholinguistic and sociolinguistic concepts. It is a practical theory because teachers who come to understand this view of reading and the related view of writing can understand what it is that learners are doing as they develop literacy.

Ken's innovative research on the process of reading which utilizes the miscues or unexpected responses of oral readers has provided an otherwise unavailable "window on the reading process" and, through that, on other language processes. His research involves all of the ethnic and socioeconomic populations who have fared poorly in American schools: Native American, rural and urban Afro-American, Hispanic, Appalachian, Pacific Islander and rural white.

As knowledge of Ken's and Yetta's discoveries has become widespread among teachers, the application of their insights into literacy development and literacy instruction by classroom teachers has been a major foundation for the Whole Language movement which is radically changing literacy education and curriculum in most English speaking countries. It is also causing changes in other countries as well. One of Ken's books, **What's Whole In Whole Language**, published originally in Canada, has sold over 200,000 copies in English, French, Spanish and Japanese. Ken's and Yetta's books and articles have been translated into thirteen (13) different languages. In addition, they are coauthors of **The Whole Language Catalog**, which contains pieces by teachers from around the world. Native American teachers contributed to the Catalog.

Ken and Yetta work closely with each other and with a large interdisciplinary group of scholars and researchers. One reason their works have been so widely understood and accepted by teachers is that their research studies have been done in the real world. They involve real learners of widely different backgrounds and abilities working in real situations. Teachers can verify Ken's and Yetta's research by observing their own pupils. Both Ken and Yetta are active members of their local teacher support group and the Whole Language Umbrella — an international grassroots organization of Whole Language teachers.

Yetta is a regents professor at the University of Arizona. She is a major voice for Whole Language and has spoken throughout the world. She has done extensive research into reading and writing processes and most recently has worked on research related to the roots of literacy in young children from many populations. For over twenty-five years, she has been involved in research related to miscue analysis and literacy development. She has popularized the term "kid-watching," widely used by learning-centered teachers to legitimatize their professional abilities to evaluate children's language growth and development and their learning.

Yetta is a past president of the National Council of Teachers of English and is a current board member of the International Reading Association. Ken is a past president of the International Reading Association and the National Conference on Research in English. He is honorary past president of the Whole Language Umbrella. Both Ken and Yetta are past presidents of the Center for Expansion of Language and Thinking.

Ken and Yetta consult regularly with national, regional and local school authorities. They provide staff development for teachers in all parts of North American and many parts of the world. Though their work has had its greatest influence to date in the English speaking industrial countries, ultimately it may have its greatest impact in third world countries which must find a basis for making education, particularly in literacy and numeracy, relevant and available to everyone. Their continuing work in Bureau of Indian Affairs schools, including hosting the "University of Arizona Holistic Science and Whole Language Workshop," and with tribes in the United States and Canada and Hawaiian Natives is part of their commitment to sensible, equitable and meaningful education for all. They view their work as important in gaining and maintaining democracy and social justice for all peoples.

The educational benefits to students participating in the "University of Arizona Holistic Science and Whole Language Workshop" are three-fold:

(1) To improve successful teaching and learning of language, math and science;

(2) To integrate math and science knowledge with language arts; and,

(3) To involve inquiry processes for Bureau of Indian Affairs teachers and their students.

While developmental costs were assumed by the Program Directors, Drs. Kenneth and Yetta Goodman, the cost of operating the program annually is $115,000, which includes housing and food for participants.

For further information you may write or call:

Dr. Kenneth S. Goodman
or Dr. Yetta M. Goodman
University of Arizona
College of Education
Department of Language, Reading and Culture
Tucson, Arizona 85729
(602) 621-7868

APPENDIX A

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SOME PAST AND CONTEMPORARY AMERICAN INDIANS IN SCIENCE, MEDICINE AND TECHNOLOGY

Ely Samuel Parker (Seneca)
Jerry Elliot (Osage/Cherokee)
Arnold T. Anderson (Iroquois)
George Owl, Jr. (Cherokee)
George W. Waller (Seneca-Cherokee)
Fred M. Bray (Choctaw)
Kevan Green (Mohawk-Onondaga)
Clifton Poodry (Seneca)
Robert Dominic, Sr. (Ottawa)
Robert Dominic (Ottawa)
Albert J. Snow (Mohawk)
Michael R. Crawford (Penobscot)
Marcia Ann Biddleman (Seneca)
Gladys Tantaquidgeon (Mohegan)
Lee David Jacobs (Mohawk)
George Blue Spruce (Pueblo)
Beryl Blue Spruce (Pueblo)
Carlos Montezuma (Apache)
Charles Alexander Eastman (Sioux)
L. Rosa Minoka Hill (Mohawk)
Lionel H. DeMontigny (Chippewa)
Susan LeFlesche Picotte (Omaha)
Everett R. Rhoades (Kiowa)
Leslie Collins (Leni Lenape)
Linwood Custalow (Mattaponi)
Thomas St. Germain Whitecloud, II (Chippewa)
Phil Terry Newkumet (Caddo)
David Powless (Oneida)
Paul Avritt (Pueblo)
Mary Ross (Cherokee)
James S. Williamson (Chippewa)
Constance Uri (Choctaw-Cherokee)
Joanne Green Labin (Mohawk-Seneca)
Frela Owl Beck (Cherokee)
Bea Medicine (Sioux)
Oscar Welch (Cherokee)
Hazel Poling (Ottawa)
Solomon Cook (Mohawk)
Carol Metcalf Gardipe (Penobscot)
Clifford Schumacher (Chippewacot)
Norman Russell (Cherokee)
Alfred Qoyawayma (Hopi)
Fred Young (Navajo)
Curtis Grinnel (Hidatsa)
Don Dillehunt (Apache)
Charlie Toledo (Pueblo)
Walton M. Youngblood (Pueblo)
F. Agnes Stroud-Lee (Pueblo)
Lloyd R. Moses (Sioux)
J. Ladd (Zuni)
Edward Dozier (Pueblo)
Ella Deloria (Sioux)
Kirmach Natani (Navajo)
Joe Jimenez (Pueblo-Nambe)
Albert Reifel (Sioux)
Johanna Clevenger (Navajo)
Andrew Acoya (Pueblo)
Claudette Bradley (Schaghticoke)
William Patrick Doss (Crow)
Eva Smith (Shinnecock)
Alexander Reifel (Sioux)
Rena Bayale (Navajo)
Bahe Billy (Navajo)
Frank C. Dukepoo (Hopi)
Robert G. Raymond (Sioux)
Evelyn Yellow Robe (Sioux)
Francis Quam (Zuni)
Frederick Dockstader (Navajo)
Alfonzo Ortiz (Pueblo)
Robert A. Ryan (Sioux)
Kristine Rayola Harvey (Apache)
Taylor McKenzie (Navajo)
Loretta S. Jendritza (Navajo)
Ronald Livermont (Sioux)
Ben Pease (Crow)
Eldon "Povi" Povitah (Navajo)
Leland Bordeaux (Sioux)
Gerald Clifford (Oglala Sioux)
Michael Trujillo (Laguna Pueblo)
Annie Wauneka (Navajo)
Benjamin Reifel (Rosbud Sioux)
Francis McKinley (Pima)
Norbert Hill, Jr. (Oneida)
Jake White Crow (Cocopah)
Lois Steele (Sioux)
Joseph A. Wyncoop (Cherokee)

APPENDIX B

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Source Book for Native American Student Math/Science Education, Linda L. Burroughs, Salt River Project, 1983

Math materials developed by Dulce Independent School District, Dulce, New Mexico

Astronomy and American Indians, cultural activities package, Oxon Hill Staff Development Center, Oxon Hill, Maryland

Native American Loom Beadwork Can Teach Mathematics, Claudette Bradley, Harvard University/M.I.T., Cambridge, MA, 1975

Science Lessons for Native Americans, developed at University of South Dakota Science Workshops, 1979, 1980 and 1981

Mathematics Curriculum With Emphasis on Examples from Indian Culture, Malik Younus, Wyoming Indian High School, 1975

Culture Through Concepts, Southwest Center for Human Relations Studies, University of Oklahoma; includes Teacher's Guide

Science — An Indian Perspective, Alan J. Allery, Division of Elementary and Secondary Education, Pierre, South Dakota 57501

Hotevillea-Bacavi Community School: An Environmentally Based Primary Curriculum, Manon Charbonneau and Jean Bingham, 1980

Science Curriculum Guide, Culture Based Curriculum for Young Indian Children, Sharon N. Thomas, Readers Publications and Sales, Salt Lake City, Utah

Introducing Science to Students Using the Environment, developed at Northern Arizona University to be available Fall, 1986 from Native American Science Education Association, Washington, DC

"A Suggested Research Map for Native American Mathematics Education," Journal of American Indian Education, January 1984

"Science Taught with a Focus on Values," R.M. Kalra, Journal of American Indian Education, January 1975

Navajo Culture and the Learning of Mathematics, Charles G. Moore, National Institute of Education, Northern Arizona University, 1982

A Kindergarten Curriculum Guide for Indian Children, Bureau of Indian Affairs, 1970

Science and Children, March 1972, special issue on the American Indian

"Science for the Native Oriented Classroom," Journal of American Indian Education, May 1982

Native American Astronomy and the Medicine Wheels of the Plains Indian, Pat Mallatt, Nebraska Curriculum Development Center, University of Nebraska, Lincoln, Nebraska

E. MATERIALS SPECIFICALLY FOR USE WITH STUDENTS

1. GENERAL

Primary Discovering, Cambridge Book Company; includes photographs of children from many different ethnic groups, including Indians

Primary-Intermediate

The Indians Knew, Tillie Pine, McGraw, 1957

The Fire Bringer, Margaret Hodges, Little, Boston, 1972

Indian Reading Series: Stories and Legends of the Northwest, Educational Systems Inc., 2360 SW 17th Avenue, Beaverton, Oregon 97005; includes Teepee, Sun and Time and others

The Stars are Silver Reindeer, Natalie Belting, Holt, Reinhart and Winston, 1966

Annie and the Old One, Miska Miles, Little, Brown & Company, 1971

Plenty Coups, Michael P. Doss, First Steck-Vaughn Edition, 1992, Steck-Vaughn Company, P.O. Box 26015, Austin, Texas 78755

Primary-Junior High

The People: Sky Lore of the American Indian, Mark Litman, Hansen Planetarium, Salt Lake City, Utah

Primary-High School

My Heart Soars, Chief Dan George, Hancock House, 1974

The Earth is Sore: Native Americans on Nature, Aline Amon, Atheneum, 1981

"American Indian Interest in the Sky As Indicated in Legend, Rock Art, Ceremonial and Modern Art," Von Del Chamberlain, The Planetarium, Fall/Winter 1974, National Air and Space Administration, Smithsonian Institution

Intermediate-Junior High

Plants That the American Indians Used, Field Museum of Natural History

Buffalo Hearts, Sun Bear, Naturegraph, 1970

Books by Robert Hofsinde, William Morrow & Company, 1986

"Inventions of American Indians," adapted by Jaci Ekern from "Indian Contributions to the World," in The Sun Child, Vol. 1, No. 2, October 1, 1978; included in this guide

The Ring on Woot-kew's Tail, Montana Reading Publications, 3311 1/2 4th Avenue North, Billings, Montana; legends of the sun, moon and stars; also other books

Red Hunters and the Animal People, Charles Eastman (Sioux), Harper Brothers, 1904; also others by Eastman

The Praying Flute, Song of the Earth Mother, Terry Shearer, Sun Books, 1975, P.O. Box 4383, Albuquerque, New Mexico 87106

Intermediate-High School

Man in Nature: America Before the Age of the White Man, Carl Saurer, Turtle Island Foundation, 2845 Buena Vista Way, Berkeley, CA 94708

Filmstrip: Indian Tools and Weapons, Indian Legacy, January Productions

Sacred Ground, film depicting Indians' relationship to the land, New Visions, P.O. Box 599, Aspen, Colorado 81611

Junior-Senior High School

The Amazing Red Man, Mack Parker, Naylor, 1960

Medicinal Plants in American Indian Life, Barrie Kavasch, Smithsonian Institution, Washington, DC

High School

Learning at the Hospital, Bob Jacobs, Native American Science Education Association, Washington, DC, 1986

"Needed: Indian Health Professionals," George Blue Spruce, Jr., D.D.S., Association of American Indian Physicians Newsletter

"Observatories 2,500 Years Old," Mark Stevens from Christian Science Monitor; included in this guide

2. REGIONAL (CENTER ONE SERVICE AREA)

Primary

Culture Based Curriculum for 3 to 5 year olds available from Tri-State Community Action Program Box 26, Cass Lake, Minnesota

The Summer Maker, Margery Bernstein and Janet Korbin, Scribner's, 1977

Primary-Intermediate

Lessons 2, 28 and 29 on Indians and nature, medicines and dye making in "The Way the Iroquois Lived" by Native American Resource Enter, Title IV-A, Rochester City School District, New York

Materials in Indian Customs, Traditions, Superstitions, Indian of North Carolina, Title IV, Part A, Robeson County Board of Education, Lumberton, North Carolina

Materials in Louisiana Indians, Carrel & Brenda Muller, Bonjour Books, New Orleans, 1985

How Summer Came to Canada, William Toye, Walck, 1969

The Dancing Stars, Anne Rockwell, Crowell, 1972

Primary-High School

"Chippewa Legend of the Stars," in Indian Legends, Iron Eyes and Birdie Parker Cody, Noteworthy Company, Amsterdam, New York, 1980

Intermediate-Junior High

"How the Tree Brothers Gave," from Around an Iroquois Storyfire
Tenase Brave, Marion Herndon Dunn, Aurora, 1971

Indians of the Longhouse, Sonia Bleeker, William Morrow, 1966

Tree Ties, game developed to teach Indians' use of natural resources, Minneapolis Public Schools, Planning Development and Evaluation Department, 807 N.E. Broadway, Minneapolis 55413

Intermediate-High School

"The Sky Beings; Thunder and His Helpers," Iroquois legend retold by Alice Mariott in
The World Beyond Ours

The Uses of Birchbark and Indian Dwellings, Wisconsin Woodland Indian Project, AILCEB, 125 S. Webster, P.O. Box 7841, Madison, Wisconsin 53707

Lenape Lore Medicines and Lenape Lore Crafts, Weapons and Tools and teaching guides from Middle Atlantic Press, Box 263, Wallingford, Pennsylvania 19086

Materials available from Cherokee Publications, P.O. Box 124, Cherokee, North Carolina 28791

Kinnikinik: A Gift of the Bear, Keewaydenoquay, 1977

Junior High School

"Building a Chippewa Indian Birchbark Canoe," Robert E. Ritzenthaler, Milwaukee Public Museum Press, 1972

Junior-Senior High School
"The Penobscot Indian Lunar Calendar," Charles Concord in The Greenfield Review, Greenfield Press, 1981

3. REGIONAL (WESTERN)

Primary
Rebus Readers, Read Aloud Stories, and Hoksila and Winona Series available from University of South Dakota, Vermilion, South Dakota

Primary-Intermediate
Books by Byrd Baylor, Scribner's

Books by Ann Nolan Clark, Viking and Farrar, Straus and Giroux

If You Lived with Sioux Indians, Ann McGovern, Four Winds School Book Service, 1974

Art and Indian Children in the Dakotas, Series of books, Bureau of Indian Affairs, available from U.S. Government Printing Office

Star Boy and The Great Race, Paul Goble, Bradbury Press

The Taos Indians and Their Sacred Blue Lake, Marcia Keegan, Simon and Schuster, 1972

Arrow to the Sun: A Pueblo Indian Tale, adapted by Gerald McDermott, Viking, 1974; also in film strip from Weston Woods Studios, Weston, Connecticut

Our Desert Friends, State of Nevada Department of Education, 1972

Materials available from Navajo Curriculum Center, Rough Rock School, Rough Rock, Arizona 86503

Primary-Junior High
Materials available from Native American Materials Development Center, 407 Rio Grande Boulevard N.W., Albuquerque, New Mexico 87104

Materials available from Shannon County Schools, Bateland, South Dakota

Primary-High School
Materials available from American Indian Curricula Development Program, United Tribes of North Dakota, 3315 S. Airport Road, Bismarck, North Dakota

Intermediate-High School
Pueblo Birds and Myths, Hamilton A. Tyler, University of Oklahoma Press, 1979

Junior-Senior High School
Metal Weapons, Tools and Ornaments of the Dakota Indians, James Austin Hanson, University of Nebraska Press

4. BIBLIOGRAPHIES

Primary-Intermediate
Charles Alexander Eastman, Dakota Physician/Author, biographical sketch with teacher's guide available from Indian Education Curriculum Project, Indian Education Section, Minneapolis Public Schools, 807 N.E. Broadway, Minneapolis, Minnesota 55413-2398

Primary-High School
Calendar and booklet with profiles of American Indians in science available from American Indian Science and Engineering Society, 1310 College Avenue, Suite 1220, Boulder, Colorado 80302

Intermediate
Dr. Taylor McKenzie, Betty Freeland, Gallup-McKinley Public Schools, 1976, Gallup, New Mexico

Intermediate-Junior High

We Rode the Wind: Recollections of Nineteenth Century Tribal Life, Lerner Publications, 1975; includes information about Charles Eastman

Red Son Rising, Adele R. Arnold, fictionalized biography of Carlos Montezuma, Dillon

Intermediate-High School

American Indian Women, Marion E. Gridley, Hawthorne, 1974; includes Susan LeFleche Picotte, Indian physician

American Indian Doctors Today, Indians Into Medicine Program, School of Medicine, University of North Dakota, 1982

Junior-Senior High School

Indian Boyhood, Charles Alexander Eastman, Dover, 1971, Fenwyn Books, 1970

Indians of Today, Marions Gridley, Indian Council Fire Press, 1971

Contemporary American Indian Leaders, Marion E. Gridley, Dodd, 1972

Who's Who Among Indian and Alaskan Native Women, National Women's Program Development, Inc., 230 Midwestern Parkway, Wichita Falls, Texas 76308

Reference Encyclopedia of the American Indian, Todd Publications

Iron Eyes' Family: The Children of Joseph LaFlesche, Norma Kidd Green, Johnson Publishing Company, Lincoln, Nebraska, 1969

Homeward the Arrow's Flight, Marion Marsh Brown, Abingdon Press, 1980, about Susan LaFlesche

Medicine Women, Indians Into Medicine Program, School of Medicine, University of North Dakota, 1985

Article on Dr. Lillie Rosa Minoka-Hill in Notable American Women, Edward T. James, Belknap Press, Harvard University, 1971

Senior High School

From the Deep Woods to Civilization, Charles Alexander Eastman, Little, 1916, University of Nebraska Press, 1977

Savage Son, Oren Arnold, University of New Mexico, 1951; about Charles Montezuma

Carlos Montezuma and the Changing World of American Indians, Peter Iverson, University of New Mexico Press

American Indian Contributions to Science, Medicine and Technology, Mary Domb Mikkelson, San Diego City Schools, Programs Division, Education Center, 4100 Normal Street, San Diego, California 92103

The Dick and Rae Physics Demo Notebook, Dr. D. Rae Carpenter, Jr. and Dr. Richard B. Minnix, Virginia Military Institute, Dick and Rae, Inc., Lexington, Virginia 24450-0304, 1993

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